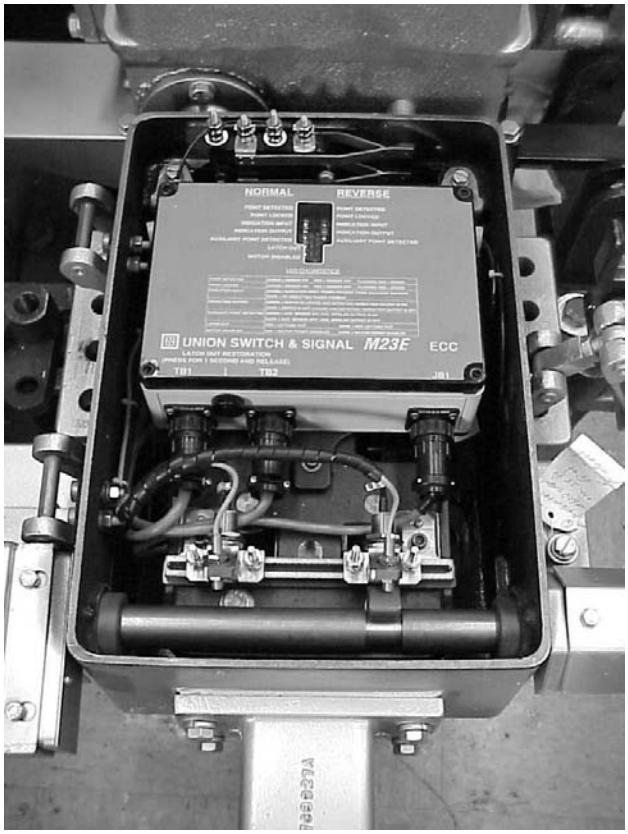
Electronic Circuit Controller (ECC)

Upgrade Kit

Installed in Existing M-3 and M-23 Style Switch Machines



Proprietary Notice

Important Notice

ASTS USA constantly strives to improve our products and keep our customers apprised of changes in technology. Following the recommendations contained in the attached service manual will provide our customers with optimum operational reliability. The data contained herein purports solely to describe the product, and does not create any warranties.

Within the scope of the attached manual, it is impossible to take into account every eventuality that may arise with technical equipment in service. Please consult an ASTS USA local sales representative in the event of any irregularities with our product.

ASTS USA expressly disclaims liability resulting from any improper handling or use of our equipment, even if these instructions contain no specific indication in this respect. We strongly recommend that only approved ASTS USA spare parts are used as replacements.

Revision History

Rev.	Date	Nature of Revision
Original	February 2002	Initial Issue
1	April 2005	Incorporated ECO EM-1771 - Update Internal Wiring Diagrams Incorporated ECO EM-1813 - Updated Motor Compartment parts list and drawing Incorporated ECO EM-1852 - Update Internal Wiring Diagrams Incorporated ECO EM-2075 - Updated Internal Wiring Diagrams Incorporated ECO 139565-277A - Changed the value of the resistor between Terminals 33 and 34 of the WAGO terminal block. Incorporated ECO 139712-155 - Updated Internal Wiring Diagrams, the PCB for the junction box, and the parts lists.
2	April 2006	Incorporated ECO EE-2013; added note on Figures 4-11 and 4-12 that deals with motor control wiring. Incorporated ECO 140050-4; Revised figures 4-10, 4-11, and 4-12 to remove the two arrestors on the AAR terminal block in the motor control compartment and replaced them with arrestor PCBs. Incorporated CRS01346 – Placed revised drawing into Figure 6-2. Changed the resistor value between WAGO terminals 33 and 34 from 820 to 750 on Figures 4-10, 4-11, and 4-12.
3	November 2010	Incorporated ECO 139712-391 and ECO 139712-392; revised Figure 4-10, Figure 4-11, Figure 4-12, and Figure 4-13. Incorporated ECO EM-2339; revised Table 6-3, Figure 6-2, Table 6-6, Figure 6-4, Table 6-8, Figure 6-5. Added Table 6-7, Table 6-8, Table 6-9, Figure 6-6, Table 6-10, Figure 6-7, and Table 6-11.

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1. INTRODUCTION

1.1. Introduction

This service manual describes the integration of the Electronic Circuit Controller (ECC) into existing M-3 and M-23 switch machines. For detailed information on the installation, operation, maintenance, and adjustment of the "M" style machines, please refer to Service Manual 6263.

1.2. Applications

1.2.1. ASTS USA Electronic Circuit Controller

The ASTS USA Electronic Circuit Controller (ECC) is designed to be applied to both the new ASTS USA M-23E style switch machine and existing "M" style machines. The ECC is designed to fit into both the M-3 and M-23 (A or B) style switch machines with permanent magnet motors.

The (ECC) uses four vital proximity sensors: two to detect the position of the switch points (normal or reverse) and two to detect that the machine is fully locked (normal or reverse).

The ECC is a microprocessor-based controller that vitally monitors the state of the four vital proximity sensors and can identify each possible sensor state (on, off, shorted, or open). In addition to the four vital proximity sensors, the ECC can be equipped with an optional auxiliary point detection system. This system provides a normally ON bipolar output to warn maintenance personnel of marginal switch machine operation. The sensing threshold of each auxiliary sensor is offset from the vital point detector sensors by approximately 1/8" to detect switch point displacement before the vital sensors indicate point detector bar movement. With the auxiliary system, switch point displacement that is caused by debris build-up or expansion and contraction of the rail can be detected before a switch failure occurs.

The M-23 with ECC proximity sensor system is a true linear detection device with no moving parts to wear. The system requires no adjustment of the point detector bar but provides internal adjustment capability of the proximity sensors, with respect to the point detector bar with the use of serrated linear slides. The point detection system provides a combination point detector bar and target that accurately reports the true displacement of the switch points. The serrated linear slide assemblies provide simple and dependable proximity sensor adjustment with respect to the target.

The ECC provides advanced diagnostics for identifying the current state of the machine and the indication state of an adjacent (daisy-chained) machine. LEDs on the ECC indicate the delivery of indication power and auxiliary indication power to the wayside, as well as provide information on motor power availability and the state of the latch-out function.

WARNING

To avoid severe personal injury, open the gold nut test link in the motor compartment prior to performing any internal machine maintenance. Always keep hands and feet clear of switch points and the internal moving parts of the machine. Ensure that loose clothing is properly secured prior to working on the switch machine.

1.3. Purpose of Manual

This service manual provides descriptive information, specifications, and installation and maintenance procedures for the ASTS USA Electronic Circuit Controller which is installed on the M-3 and M-23 Switch Machines.

1.4. Abbreviations, Acronyms, and Definitions

ac	alternating current
AAR	Association of American Railroads - Communication and Signal Section (currently known as AREMA)
AREA	American Railway Engineering Association
AREMA	American Railway and Maintenance of Way Association (formerly known as AAR)
AWG	American wire gauge
CAUTION	Caution statements indicate conditions that could cause damage to equipment.
dc	direct current
ECC	Electronic Circuit Controller
Front of Machine	The physical area of the switch machine closest to the motor.
FRA	Federal Railroad Administration
Latch-Out	A device that does not allow switch point indication to restore if the switch point moves away from the stock rail (point detection is momentarily lost). This function will be activated if the point sensors are actuated before their corresponding locking sensors are actuated.

Latch-Out Restoration	The term latch-out restoration refers to resetting the machine to an operable switch machine indication state from a latched-out condition.
LED	Light-emitting diode
Left-Hand Switch	The position of a switch machine designated when the machine is located on the left-hand side of the track, looking into the switch points in the direction of the arrow as shown in Figure 1-1.
LHPC	"Left-hand point closed," which refers to the switch point position when the point is normally closed to the left-hand side, looking into the switch points in the direction of the arrow as shown in Figure 1-1.
PD	Point detector or point detection (as in "PD bar").
Point Detection	The positive indication achieved when the switch points are closed adequately against the stock rail.
Locking	Locking is achieved when the lock box, connected to the slide bar, enters the narrow locking notch of the lock rods and extends a minimum of 1/2" into the locking rod.
MCU	Motor control unit - a high-current, solid-state device used to control motor power.
MOV	Metal oxide varistor (protection device for electronic components).
Non-Vital Circuit	Any circuit with a function that does not affect the safety of train operation.
PCB	Printed circuit board
Rear of Machine	The physical area of the switch machine furthest from the motor.
Reference Designator	An abbreviation assigned to designate an electrical component. It generally consists of a capital letter and a number. Each letter designates a particular type of component. For example, "L" identifies an inductor and "R" identifies a resistor.
Right-Hand Switch	The position of a switch machine designated when the machine is located on the right-hand side of the track, looking into the switch points in the direction of the arrow shown in Figure 1-1.

RHPC	"Right-hand point closed," which refers to the switch point position when the point is normally closed to the right-hand side of the track, looking into the switch points in the direction of the arrow shown in Figure 1-1.
rms	root-mean-square (method for expressing ac voltage rating)
Switch Machine Indication	A vital determination of a safe switch configuration, due to positive indication that the switch machine has properly thrown, locked and detected switch point closure.
Switch and Lock Movement and/or Mainline Switch Machine	A device which performs the three operations of unlocking, operating, and locking a switch, movable point frog, or derail.
Vital Circuit	Any circuit with a function that affects the safety of train operation.
WAGO®	Registered trademark for WAGO Corporation.
WARNING	Warning statements indicate conditions that could cause physical harm, serious injury, or loss of life.

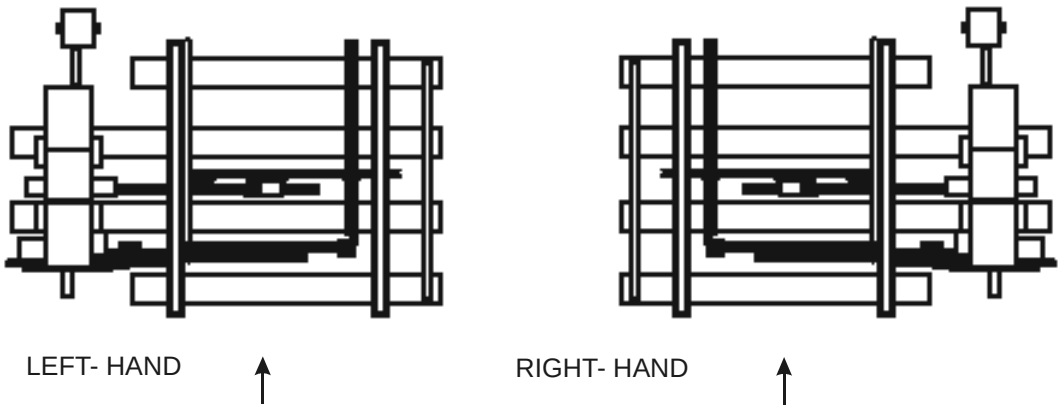


Figure 1-1. Left-Hand and Right-Hand Switch Machines

1.5. Safety

Read and thoroughly understand this manual before attempting any of the procedures listed. Pay particular attention to the **WARNING** and **CAUTION** statements that appear throughout this manual. Always observe standard precautions familiar to trained electrical technicians. Always adhere to all safety regulations stipulated by the railroad.

2. EQUIPMENT DESCRIPTION

Please refer to

Figure 2-1 for a block diagram of the ECC System.

2.1. Junction Box

The ECC box is connected to the junction box via cable JB1. The junction box is the junction point where the four vital sensors (two for point detection and two for locking detection) and two optional auxiliary (non-vital) sensors are terminated via a six-way cable grip. This termination method allows for convenient replacement of any individual sensor in the system.

The junction box also has two jumper sets that provide the ECC box with the configuration information for determining which point is normally closed [left-hand point closed (LHPC) or right-hand point closed (RHPC)] and which type of latch-out configuration has been selected (manual restoration, automatic restoration, or latch-out disabled completely).

2.2. WAGO Terminal Strip

The ECC box is connected to the WAGO terminal strip in the motor compartment with two plug-connected cables, TB1 and TB2. Both plug connectors are keyed differently so they cannot be interchanged on the ECC box. The WAGO terminal strip is the integration point of the ECC system where all field wires for switch indication and the wayside battery feed to the ECC system.

The WAGO terminal strip is also the termination point for the machine's cycle counter and the optional local/remote request switch. In addition, it is equipped with a series of 14 gas tube lightning arrestors for lightning protection.

2.3. Motor Compartment

The motor compartment is equipped with an eight-way AAR binding post strip for field, motor power cable wires and motor control unit termination. Two of the AAR posts are strapped with a "gold nut" to open motor power to the machine.

The motor control unit (MCU) houses the high-powered FET electronic motor control circuitry. The FET circuitry turns OFF motor power at the end of each stroke (only after the machine is fully locked). This feature eliminates the need for a large motor with high armature inertia to complete the machine's stroke in adverse weather conditions.

The local/remote request switches are used to locally operate the machine similar to a wayside local control panel. One toggle switch is used to take local or remote control, and the other toggle switch is used to cycle the machine from normal to reverse and vise versa.

The cycle counter tallies each complete cycle of the switch machine (i.e., the counter increments each time the machine completes a cycle from normal to reverse and back to normal again). The counter cannot be reset so the operational history of the machine is preserved.

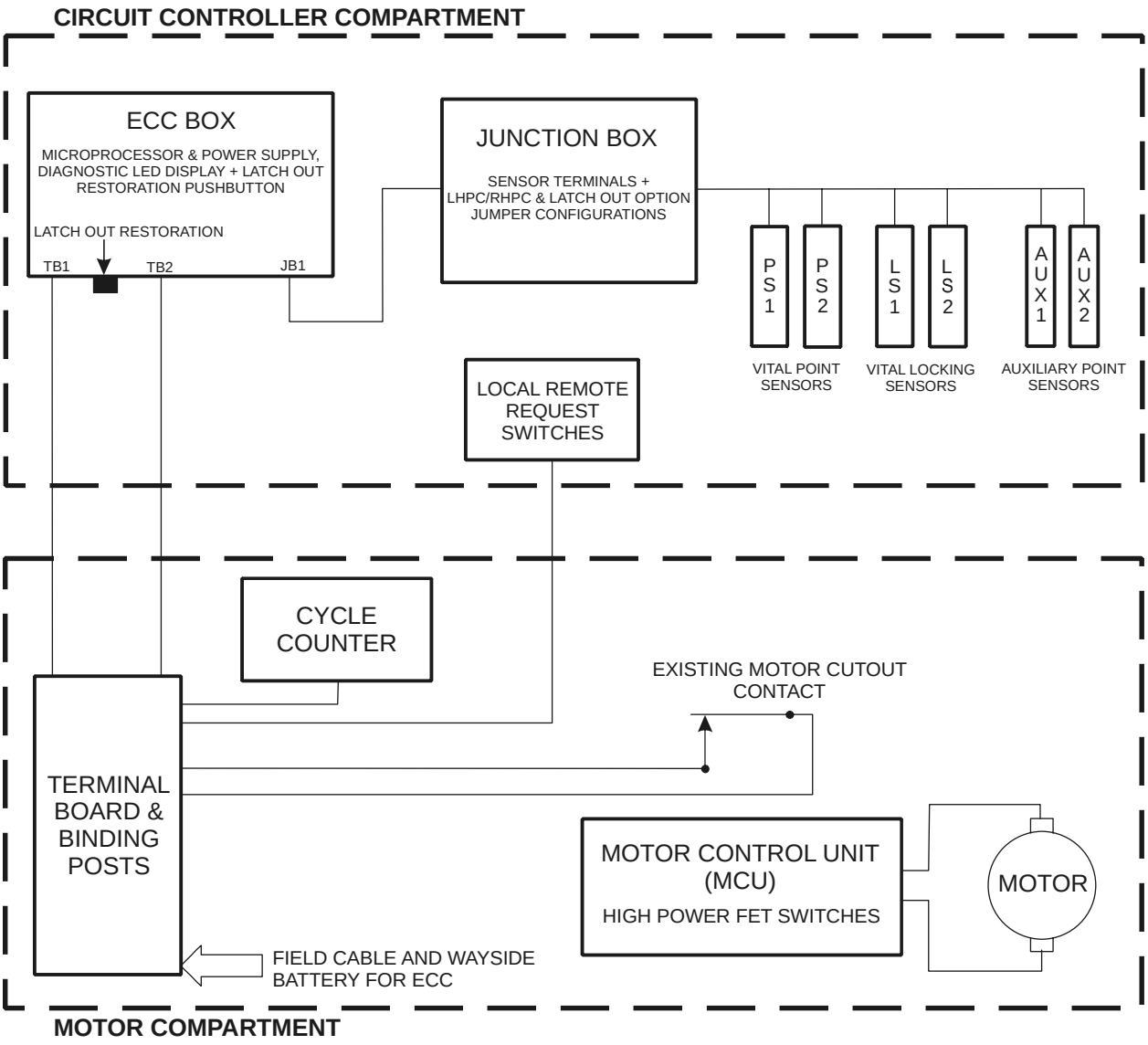


Figure 2-1. ECC System Block Diagram

3. FUNCTIONAL DESCRIPTION

3.1. Functional Overview

The ECC system is functionally equivalent to the ASTS USA N285638 circuit controller mechanism. Being electronic, it has no mechanical contacts or cam arrangements. The motor control unit (MCU) emulates the motor cutout contacts from the mechanical controller in that it is continuously set up to move the machine to the opposite direction when in the full normal or reverse positions. This MCU provides the same "make-before-break" motor control circuitry as in the existing M-3/M-23 controllers.

All proximity sensors used in the ECC system, vital and auxiliary (non-vital), are used under normally ON conditions. In other words, no logic condition of the ECC is dependent upon the point detection, locking, or auxiliary sensors being OFF to make a decision. The only time the OFF state of the sensors is relevant is when determining the locked and detected position of the machine. For example, for the switch indication to be energized in the Normal position, both the normal point and lock sensors must be ON *and* the reverse point and lock sensors must be OFF.

The vital point and lock sensors work in predetermined pairs and each of the two-paired sensors, one point and one lock, are "ANDed" (linked) together. To receive a normal switch indication output from the ECC, both the point and lock sensors for the normal position must both be energized or ON. The same is true for both point and lock sensors for the reverse position. If either one of the two paired sensors is OFF, in either switch position, the switch indication output is OFF for that position. The paired sensors are labeled PS1 and LS1 and PS2 and LS2. Which pair of sensors corresponds to the normal position is dependent upon the position of the LHPC/RHPC jumper position in the junction box (refer to Figure 3-1).

When the machine is locked and the points are detected in either the normal or reverse positions (illustrated by the point detected and point locked LEDs) and the corresponding indication input is present or energized, the indication output LED for that switch position will be illuminated on the ECC. This is a direct confirmation that indication power (approximately 12 VDC) is leaving the machine.

3.1.1. Latch-Out

If the machine is locked and detected in either the normal or reverse positions and the points move away from the stock rail, the ECC will electronically latch-out, turning OFF the indication output for that position and holding it out (in a manner depending on the latch-out jumper position in the junction box). A latch-out condition is indicated by the illumination of the RED Latch-out LED on the ECC. The latch-out can be restored either manually or automatically.

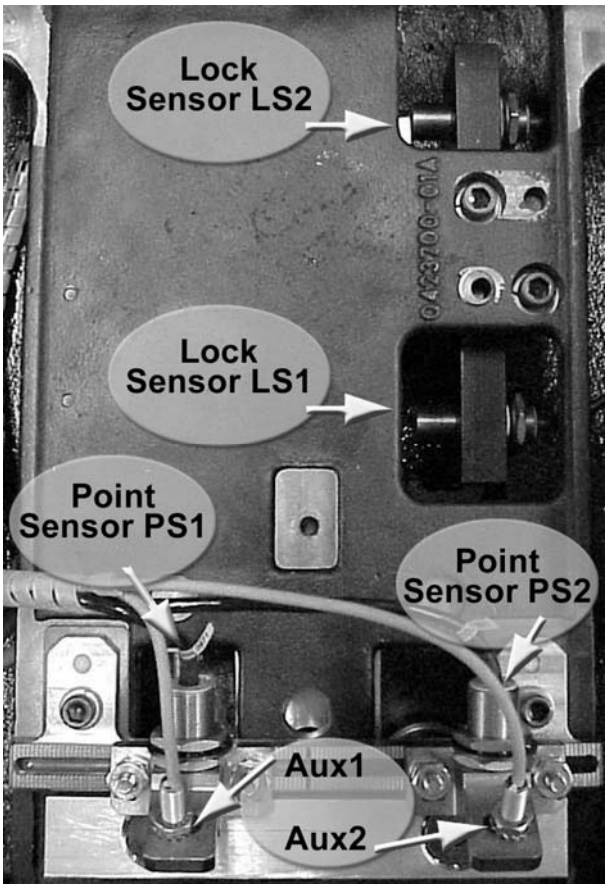


Figure 3-1. View Standing at Controller End of Machine with ECC Box Removed (Aux Sensors Shown Are Optional)

3.1.1.1. Manual Restoration

NOTE

In the manual restoration mode, the latch-out cannot be restored in either the hand throw or power mode of operation. Maintenance personnel **must** depress the latch-out restoration pushbutton to restore a latched-out condition.

The latch-out can be restored manually by pressing the momentary latch-out restoration pushbutton on the ECC for one second and releasing (this can be done in either the manual or automatic restoration modes but will only occur if the point and lock sensors are properly indicating).

3.1.1.2. Automatic Restoration

The latch-out can be restored by moving the machine *toward* the opposite position, until all four vital sensors are OFF, and then returning to the original position (this will occur only in the automatic latch-out jumper mode and only if the point and lock sensors are properly indicating).

The latch-out feature can also be completely disabled by placing the junction box jumper in the "disabled" latch-out position.

The ECC also continuously monitors the states of the two auxiliary sensors mounted on the linear slides above the two vital point detector sensors. The auxiliary sensors offset from the vital sensor by a 1/8" sensing range differential. This means that if the vital sensor is adjusted to detect a 1/4" linear displacement of the point detector bar (i.e., turn OFF), the auxiliary sensor will turn OFF after the bar has displaced only 1/8". Similarly, if the vital sensor is adjusted to sense 3/8" point detector rod movement, the auxiliary sensor will turn OFF after the bar has moved 1/4". This 1/8" differential provides the ability to *predict* a switch failure caused by sand or ice building up in the switch points or switch point movement resulting from extreme temperature changes, etc. The auxiliary sensors indicate that while the machine is still within the FRA guidelines for maintaining switches, the machine is on the verge of being obstructed. A normally energized bipolar output is provided on the WAGO terminal strip to be utilized on the wayside to notify operators or maintenance personnel that a problem is developing.

The mechanical motor cutout contact in the existing "M" style machine is still utilized to both remove motor power *and* de-energize indication circuits when opened. The existing contact arrangement is terminated on the WAGO terminal strip in the motor compartment and is placed in series with an 750-ohm resistor. When the contact is opened the series resistive circuit to the ECC is opened and the MCU is disabled. When this occurs, the RED motor disabled LED illuminates on the ECC. Motor power is now disabled while ECC power still remains for troubleshooting capability.

Both the normal and reverse indication outputs are shunted when not in use. When the machine is fully locked and detected in the normal position, for example, the reverse indication output is shunted. This is identical to using the shunt bar on existing "M" style circuit controllers.

A continuous wayside battery feed to the ECC is required to power the unit. The ECC will operate over a range of 10 to 16 VDC; however, it is recommended that the unit has a minimum voltage level of 12 VDC measured between Terminals 17 and 20 on the WAGO terminal strip in the motor compartment (refer to Step 5 of Section 4.4.1).

3.2. ECC Diagnostic Information

The ECC is equipped with a series of LEDs to indicate the current state of the switch machine. Dual-colored LEDs are provided to indicate the state of each vital point and lock sensor. Green LEDs are provided for indication input, indication output and auxiliary sensor state definition.

Red LEDs are provided to determine when the motor is disabled and when the ECC is in a latched out state.

Table 3-1 describes what the ECC diagnostics represent.

3.2.1. Diagnostic Modes of Dual-Colored LEDs

The dual-colored LEDs that represent the states of the vital point and lock sensors have three possible diagnostic modes: red, or flashing red as illustrated in Table 3-1. Green simply means the sensor is ON and is detecting its specified target. Red means the sensor is OFF and not sensing the target. Flashing red indicates an indeterminate state (i.e., not ON or OFF). In order to definitively distinguish between an ON and an OFF sensor state, an indeterminate operating window is used between the two states. As the target approaches the sensor, the sensor will change from the OFF state to an indeterminate state and then to the ON state. The LED will represent this by changing from red to flashing red and then to green. The ECC will also produce a flashing red LED if the vital sensors are shorted, open, or wired incorrectly. During normal switch operation, the flashing red transition through the indeterminate state will not be noticeable.

The green LEDs for indication input and indication output are powered from the actual working voltages in the machine and not energized based on the microprocessor interpretation of the machine state. The indication input LEDs are powered by the voltage present on WAGO Terminals 13 and 15 for normal and 10 and 12 for reverse. The indication output LEDs are powered by the ECC power supply delivering the 12-volt indication output potential to the terminals on the WAGO strip (Terminals 1and 3 for bipolar and Terminals 4, 6, 7, and 9 for four-wire indication circuits).

Table 3-1. LED Diagnostics

Switch Condition	LED Condition	Indication
Point Detected	Green	Sensor On
	Red	Sensor Off
	Flashing Red	Indeterminate
Point Locked	Green	Sensor On
	Red	Sensor Off
	Flashing Red	Indeterminate
Indication Input	Green	Indication input power present from adjacent machine
	Dark	No indication power present
Indication Output	Green	Switch is locked and detected/indication output is on
	Dark	Switch is not locked and detected/indication output is off
Auxiliary Point Detected	Green	Aux. sensor on/aux. bipolar output is on
	DARK	Aux. sensor off/aux. bipolar output is off
Latch-out	RED	Latched out
	DARK	Not latched out
Motor Disabled	RED	Motor power disabled
	DARK	Motor power enabled

4. INSTALLATION

WARNING

To avoid severe personal injury, open the gold nut test link in the motor compartment prior to performing any internal machine maintenance. Always keep hands and feet clear of switch points and the internal moving parts of the machine. Ensure that loose clothing is properly secured prior to working on the switch machine.

4.1. Junction Box Jumper Configuration

4.1.1. RHPC/LHPC Jumpers

All right-hand and left-hand M-23 switch machines are configured from ASTS USA with the switch point closest to the machine designated as the "normally closed" or normal point. Therefore, all right-hand machines are shipped with the jumper in the RHPC position and all left-hand machines are shipped with the jumper in the LHPC position. Because the same terminals on the WAGO terminal strip are always used for normal and reverse indication, regardless of the RHPC/LHPC jumper position, it is necessary to move the jumper to the opposite position if the normally closed switch point is furthest from the machine installation.

4.1.2. Latch-Out Jumpers

The latchout jumper for all ASTS USA "M-style" switch machines is set for either the automatic, manual, or disable function. This configuration is set at the factory based on customer preference at the time the order was placed. To change this configuration, remove the junction box cover and reposition the jumper. See Section 3.1.1 for a detailed explanation of each jumper function. See also Figure 4-1 for the various jumper positions.

4.1.3. Changing the Jumper Configuration

1. Disconnect plug connectors TB1, TB2, and JB1 from the ECC by rotating the coupler collar counterclockwise and extracting the male end.

2. Ensure that the machine is in the full locked position with the lock box extended toward the gearbox.

3. Remove the internal point detector bar target by removing the Allen head set screw and socket head cap screws securing the target and sliding the bar out of the machine.

4. Remove the two Allen head countersink screws securing the PD target guard underneath the PD bar area.

5. Remove the two hex bolts securing the circuit controller frame near the gearbox.

6. Unfasten the cable/wire restraint holding ECC cables TB1 and TB2.

7. Remove the controller frame assembly to access the junction box (located on the left side of the controller frame looking into the gearbox).

8. Remove the junction box cover by removing the four screws at the corners of the cover.

9. Change the jumpers to the desired configuration (RHPC/LHPC and/or Latch-Out jumpers). Figure 4-1 shows the location of the jumpers on the junction board in the junction box.

10. Replace the junction box cover and resecure the controller frame assembly.

11. Insert the point detector bar and secure the target using the hardware removed in Step 3.

12. Reconnect TB1, TB2, and JB1 plug connectors.

4.2. ECC Power and Indication Input Setup

The ECC requires a continuous wayside battery feed of 12 VDC, connected to WAGO Terminals 17 (N12) and 20 (B12).

Indication input can be set up either for a single machine (such as an end-of-siding application) or multiple machines (such as a daisy-chained crossover).

4.2.1. Single Machine Setup

The indication input to the ECC must be jumpered on the WAGO terminal strip to receive continuous battery feed. The ECC is shipped from ASTS USA with these jumpers installed and must be removed for multiple machine applications.

Referring to the wiring diagrams in Figure 4-10, Figure 4-11, and Figure 4-12 four jumpers must be installed. Terminal 16 for N12 is connected to Terminal 13 (normal input -), which is also jumpered to Terminal 10 (reverse input -). Terminal 19 for B12 is connected to Terminal 15 (normal input +) which is also jumpered to Terminal 12 (reverse input +).

With the above jumper configuration in place, both green LEDs for indication input will always be illuminated in the ECC box to indicate continuous power is being supplied to the indication input circuits.

4.2.2. Multiple Machine Setup

If the machine is the **first** machine in the crossover (i.e., the indication output is not dependent upon the indication input from an adjacent machine), the indication input circuits are to be jumpered as described in the above paragraph for a single machine application.

If the machine is the **second** machine in a crossover application (i.e., requires indication input from the first machine to properly deliver indication output to the wayside), indication input jumpers are not used. The indication input circuits of the **second** machine are to be fed from the indication output of the **first** machine to ensure that both machines in the crossover are locked and detected in the correct position.

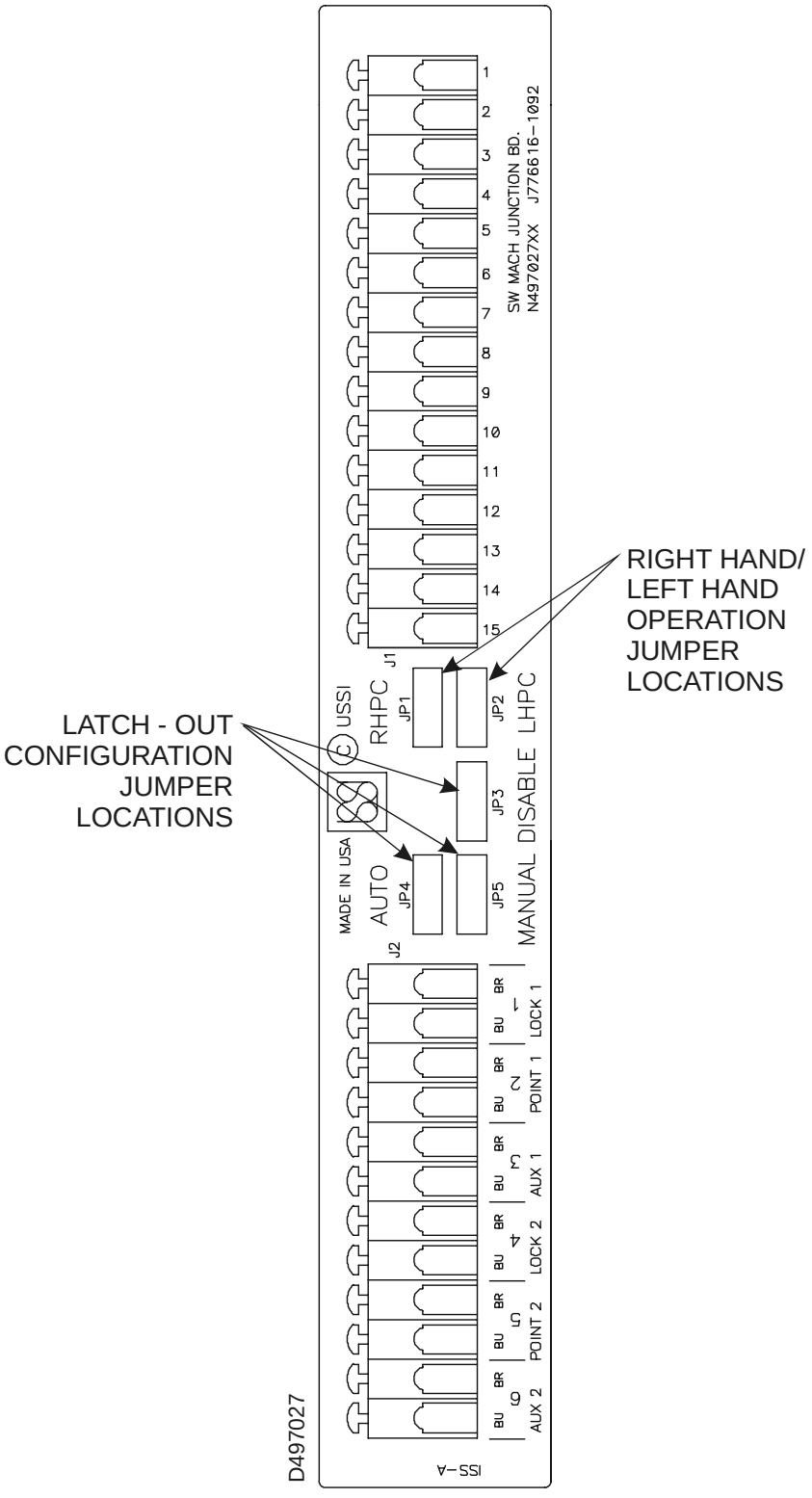


Figure 4-1. Jumper Locations on the Junction Board

4.3. Point Detector and Auxiliary Sensor Adjustment

NOTE

Auxiliary sensors are optional, non-vital sensors and are only supplied when required by the customer.

4.3.1. Point Detector Sensor Gap

The vital and auxiliary (non-vital) point detector sensors (Figure 4-2) must be located at a fixed dimension to optimize sensor response and performance. The vital sensors are to be gapped to 0.075" from the face of the PD target and the auxiliary (non-vital) sensors are to be gapped at 0.040" from the face of the target. The tightness of the feeler gage between the head of the sensors and the target is not critical regarding the performance of the sensors.

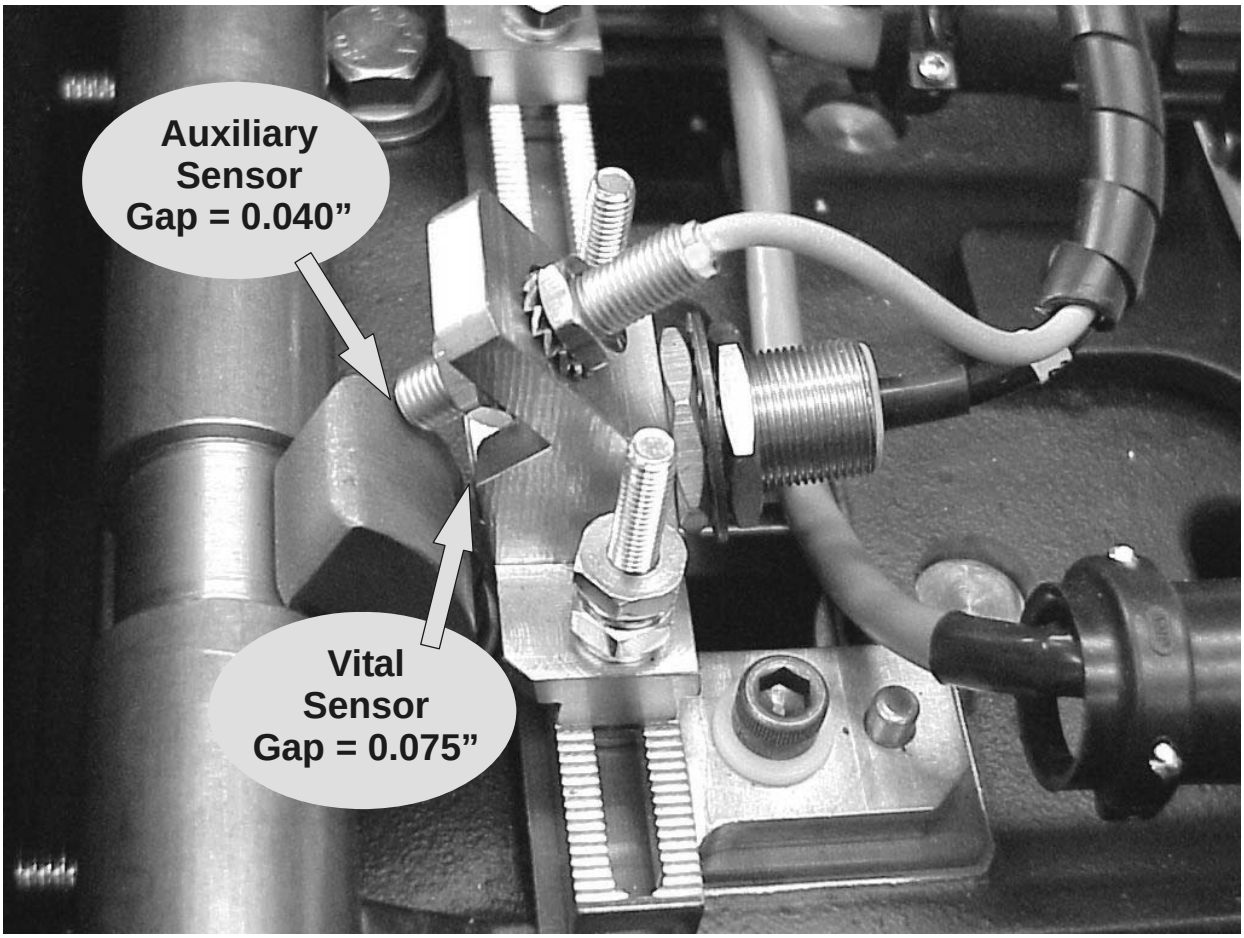


Figure 4-2. Sensor Gap Definition (Non-Vital Sensor Shown is Optional)

4.3.2. Point Detector Sensor Adjustment

The vital point detector sensors (Figure 4-3) are mounted on serrated adjusting brackets, which can be adjusted in 1/16” linear increments.

4.3.2.1. Initial Set-Up

Adjust the point detector bar so that the PD target is centered or equally balanced in the machine (see Figure 4-3) when the points are in the mid-stroke position. The point detector bar should travel equidistant from the center of the controller compartment when the switch travels from one extreme position to the other.

1. Move the switch machine to one extreme position (N or R, it is not critical) and ensure that the switch point is closed and up against the stock rail.

2. Loosen the PD bracket AAR nuts. Lift the serrated bracket and slide the sensor toward the PD target, keeping the bracket elevated so as not to engage the serrations.

3. Move the sensor to the target’s edge until the corresponding Point Detected LED just turns Green on the ECC box.

4. Lower the serrated bracket to determine the ON/OFF threshold location in the serrations. Lift and move the sensor bracket three (3) additional serration positions (3/16”) toward the center of the machine to assure that the sensor is not adjusted right on the ON/OFF threshold. This will ensure that a 1/4” point obstructed will be detected, however the points will be allowed some movement (up to 3/16”) so as not to cause intermittent indication failures under shock and vibration conditions.

5. The sensitivity of the vital sensors can be adjusted in 1/16” increments to accommodate for excessive lost motion in the external point detection connections.

6. Tighten the AAR hardware to properly secure the sensor bracket.

7. Place a 1/4” obstruction in the switch point, 6” back from tip of point. It may be necessary at this time to “float” the lock rods to allow the switch machine’s slide bar to travel full stroke to properly check the point detection settings. This is accomplished by loosening the hardware on the lock rod assembly and moving the lock rods so that the lock dog of the machine can enter the narrow notch.

8. With the obstruction placed in the switch point, the corresponding normal or reverse point detected LED should be RED. If not, repeat the serrated bracket adjustment procedure (Steps 1 through 4), moving the bracket only two serrations into the target instead of three.

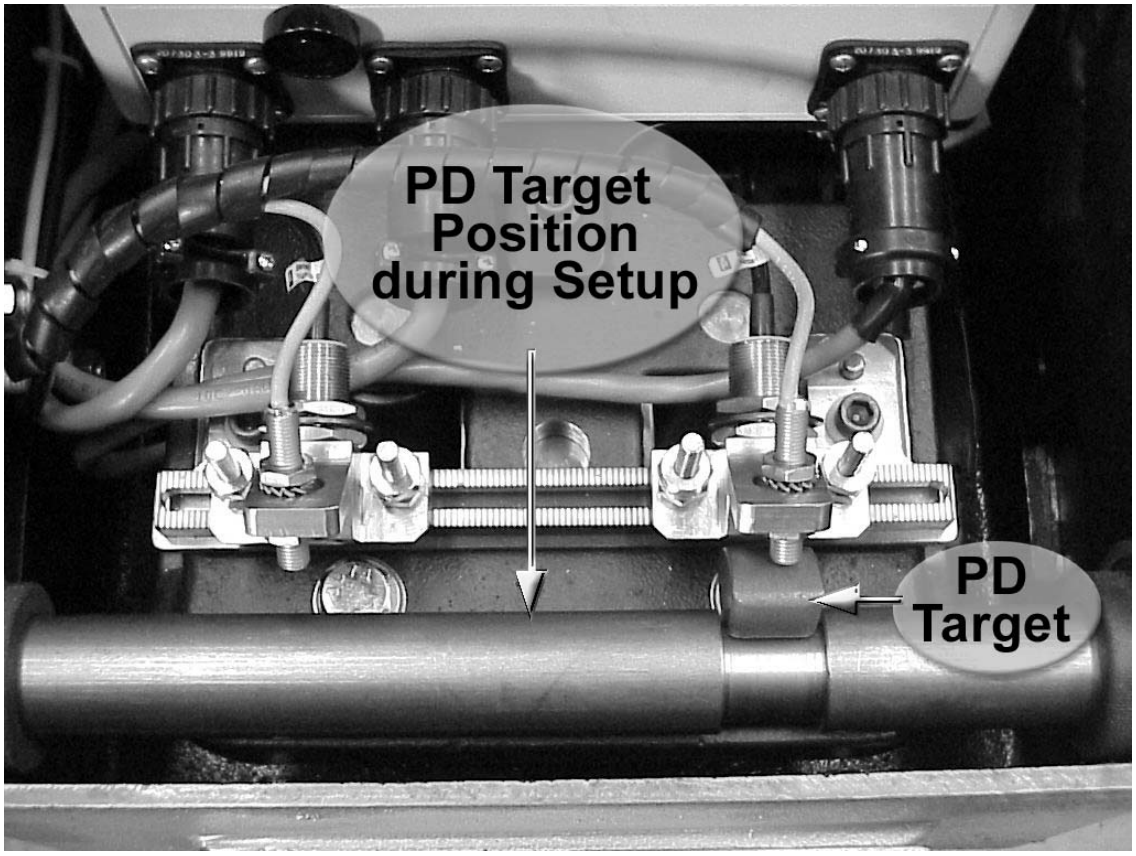


Figure 4-3. Initial Point Detector Bar Setup

9. If the machine has been equipped with the optional auxiliary sensors, their position is fixed and no adjustment is required.

4.3.3. Auxiliary Sensor (Non-Vital)

NOTE

Auxiliary sensors are optional, non-vital sensors and are only supplied when required by the customer.

1. Place the switch machine in the Normal position (operating bar based on RH or LH configuration).

2. Move the point detector bar to the Normal position matching the machine in Step 1.

3. Starting with the sensor holding bracket outside the target area (at the extreme position of the bracket mounting plate), slide the sensor holding bracket toward the target until the LED for Point Detected Normal just turns green on the ECC. This is the starting point for the Vital Sensor (18mm).

4. Slide the sensor holding bracket two more serrations into the target corresponding to the 1/8" point movement differential (each serration is 1/16" on center) and hand tighten to prevent movement.

5. Slide the auxiliary sensor toward the target until the LED for Auxiliary Point Detected just turns green. After ensuring a gap of 0.040" between the target and sensor face, secure the hardware for the sensor. Tightness of the feeler gauge between the sensor head and the target is not critical.

6. For the Reserve position (operating bar out based on RH or LH configuration), repeat Steps 1 through 5 above. This time look at the LED's that correspond to the Reverse Position on the ECC.

4.4. Wiring and Motor Control

4.4.1. WAGO Terminal Strip Connections

WAGO Terminal strip connections are as follows (Figure 4-10, Figure 4-11, and Figure 4-12 illustrate the internal wiring diagram of the ECC system).

1. Terminals 2, 5, 8, 11, 14, 18, and 22 are internally connected to the DIN rail and serve as a means by which the 14 gas tube lightning arrestors make contact with the base of the machine. ***No other wires should be terminated to these points*.**

2. Terminals 1 and 3 are for field connections to a two-wire, bipolar indication output circuit.

   a. Normal indication is defined as (+) on Terminal 3 and (-) on Terminal 1.

   b. Reverse indication is defined as (-) on Terminal 3 and (+) on Terminal 1.

   c. If there is no output, Terminals 1 and 3 are shunted.

3. Terminals 4, 6, 7, and 9 are for field connections to a four-wire indication output circuit.

   a. Normal indication is defined between Terminals 7 and 9, (9 being positive and 7 being negative).

   b. Reverse indication is defined between Terminals 4 and 6, (6 being positive and 4 being negative).

c. If there is no output on the paired terminals, they are shunted.

CAUTION

When connecting the ECC Indication Outputs to the drive switch correspondence relays, ensure the relay controls are properly snubbed with a resistor to minimize the possible inductive kickback to the ECC when the field in the relay coil collapses.

Ensure that no external source is applied across any of the outputs.

4. Terminals 10, 12, 13, and 15 are for indication input field connections from an adjacent machine's indication output circuit or can be jumpered in the application of a single machine.

   a. Normal indication input is defined between Terminals 13 and 15, (15 being positive and 13 being negative).

   b. Reverse indication input is defined between Terminals 10 and 12, (12 being positive and 10 being negative).

   c. If the machine is used in a single machine application, battery must be fed to the Indication Input circuits to provide indication output. Refer to Section 4.2 for proper jumper configuration.

NOTE

Four indication input jumpers are factory installed on the WAGO terminal strip and must be removed for multiple machine applications.

5. Terminal 17 is used for connecting wayside battery N12. Terminal 20 is used for connecting wayside battery B12. Note that there are factory installed jumpers between paired Terminals 16 and 17 and between paired Terminals 19 and 20. Wayside battery can be fed to either available terminal of each pair.

6. Terminals 21 and 23 are for field connections to the two-wire, bipolar auxiliary sensor output.

   a. Normal auxiliary indication is defined as (+) on Terminal 23 and (-) on Terminal 21.

   b. Reverse auxiliary indication is defined as (-) on Terminal 23 and (+) on Terminal 21.

WARNING

The maintenance output is **not vital** and should never be used to clear signals.

7. Terminals 24, 25, and 26 are for field connections to utilize the local/remote request switch option. This function will be particularly useful when conducting monthly inspections. In order for this function to work, however, the wayside must be so configured. Basically the two toggle switches in the machine (L/R and N/R) interface with the local control panel providing the ability to control the machine as though operating directly from the local control panel. The local/remote (L/R) switch normally is to be in the remote position. When placed in the local position, battery + is routed to Terminal 26. The local control panel is thus activated to receive commands from maintenance personnel at the machine. The second switch (N/R) is a center OFF spring return toggle. When held in the N position, the machine is electrically driven from the wayside controller to the normal position. If the switch is released before the stroke is complete, the motor will coast to a stop.

CAUTION

The LOCAL REQUEST position will override the dispatches' control of the machine. It, therefore, is important to return the L/R switch to the Remote position upon completion of maintenance.

8. Terminals 27 through 31 are for termination of the MCU and are also used to terminate the cycle counter.

4.4.2. Motor Control

ON MOTOR FRONT and ON MOTOR REAR are used to turn off motor current at the end of the stroke. For example, if the motor is turning to produce motion of the lock box toward the motor compartment (front end of the machine), both ON MOTOR FRONT and ON MOTOR REAR are + relative to GND. When lock sensor LS2 turns ON, the ON MOTOR FRONT line switches to GND. In response, the motor controller opens the motor to the polarity of current that would continue motion in the same direction. Additionally, the counter is energized momentarily and one count is registered. Operation in the opposite direction is the same with ON MOTOR REAR switching to stop the motor; however, the counter does not respond.

Terminals 32 through 34 are the termination points for the motor cutout circuits. In an M-23 upgraded with an ECC, the existing motor cutout contact in the circuit controller compartment is to be connected to Terminals 32 and 33. An 750-ohm resistor is series connected in the circuit to disable motor power when the selector lever is actuated for hand throw operation.

4.5. AREMA Terminal Post Connections

There are eight (8) AREMA binding post terminals, labeled 1 through 8, accordingly.

1. Terminal 1 is the termination point for the red MCU control wire, one of the two field motor control wires. It also serves as a terminal for the surge suppressor PCB used for lightning protection.

2. Terminals 2 and 3 are common terminals used for grounding purposes. They are also terminals for the surge suppressor PCBs connected to Terminals 1 and 4.

3. Terminal 4 is the termination point for the second field motor control wire and for Terminal 52 from the hand throw contacts. It also serves as a terminal for the surge suppressor PCB used for lightning protection.

4. Terminal 5 is the termination point for Terminal 51 from the hand throw contacts; Terminal 6 is the termination point for the negative internal permanent magnet motor wire. **A "gold nut" test link is provided between these two terminals to disconnect motor power when performing maintenance on the machine.**

5. Terminals 7 and 8 are designated for motor compartment, heater wire termination.

4.6. Sensor Identification and Termination in the Junction Box

The vital point detector sensors are designated PS1 and PS2. The vital locking sensors are designated LS1 and LS2. The auxiliary point detector sensors are designated Aux1 and Aux2. It is important to note that PS1 and LS1 always work in combination together and PS2 and LS2 always work together as well. Refer to Figure 3-1.

The four vital and two optional auxiliary (non-vital) sensors are all terminated inside the Junction Box (Figure 4-1) located underneath the circuit controller frame. All six sensor wires are brought into the junction box through a six-way cable grip and their brown and blue wires are terminated in WAGO cage clamp connectors. The PC board inside the Junction Box identifies which sensors connect to each terminal and the color designation of each sensor wire (BR for brown and BU for blue). If any of the four vital sensors are wired incorrectly, the corresponding LEDs on the ECC will be Flashing Red. If the auxiliary sensors are wired incorrectly, they simply will not operate. There is a yellow LED on the back end of each auxiliary sensor to determine if it is operating properly.

4.7. 3- and 5-Wire Conversion to 2-Wire Control

Figure 4-9 illustrates a typical 3- and 5-wire relay control scheme converted to the recommended 2-wire control system. Conversion from a 5- to 2-wire configuration is best suited for changes in the wayside house or bungalow. A 3- to 2-wire conversion can be performed at the wayside location or in the machine by connecting two of the three wires together as shown.

4.8. Right-Hand to Left-Hand Conversion (and Vice Versa)

4.8.1. Conversion of Gearbox

NOTE

Although this procedure can be done in the field, ASTS USA recommends this procedure be done in the shop.

4.8.1.1. Dismantling (Refer to Figure 4-4, Figure 4-5, and Figure 4-6)

1. Remove the two 5/8-11 x 2” hex head bolts securing the gearbox cover to the gearbox and lift the cover; retain the cover to use as a receptacle for the parts which will be removed in future steps.

2. Place the hand-throw lever in the Normal position and the selector lever in the Motor position. The machine must be in its full stroke position. Insert a 1/2” drive into the adjusting nut on the friction clutch assembly (R) and turn it to drive the mechanism to its complete full stop (Figure 4-4).

3. Remove the four 1/2 -13 bolts (A1) and lock washers securing the top bearing (C). (One of these bolts will be 3/4" longer than the others.)

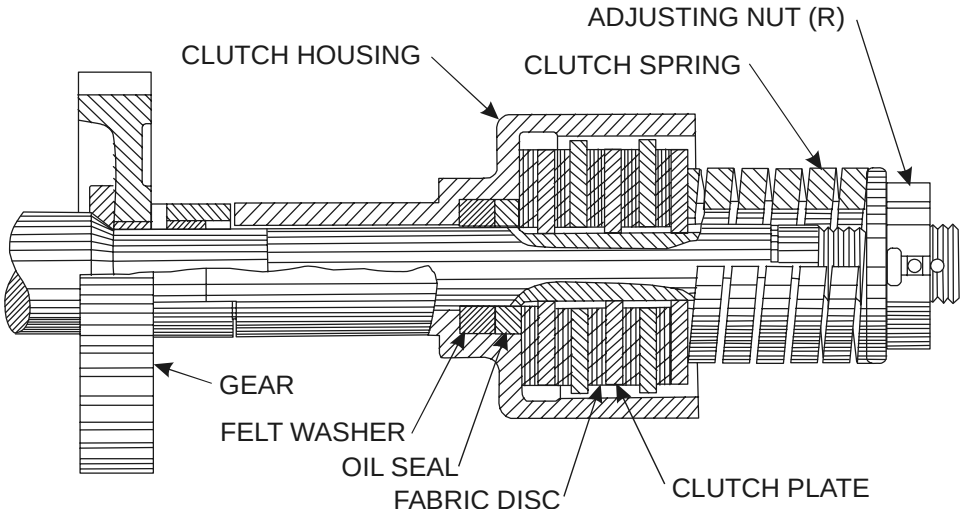


Figure 4-4. Friction Clutch Assembly

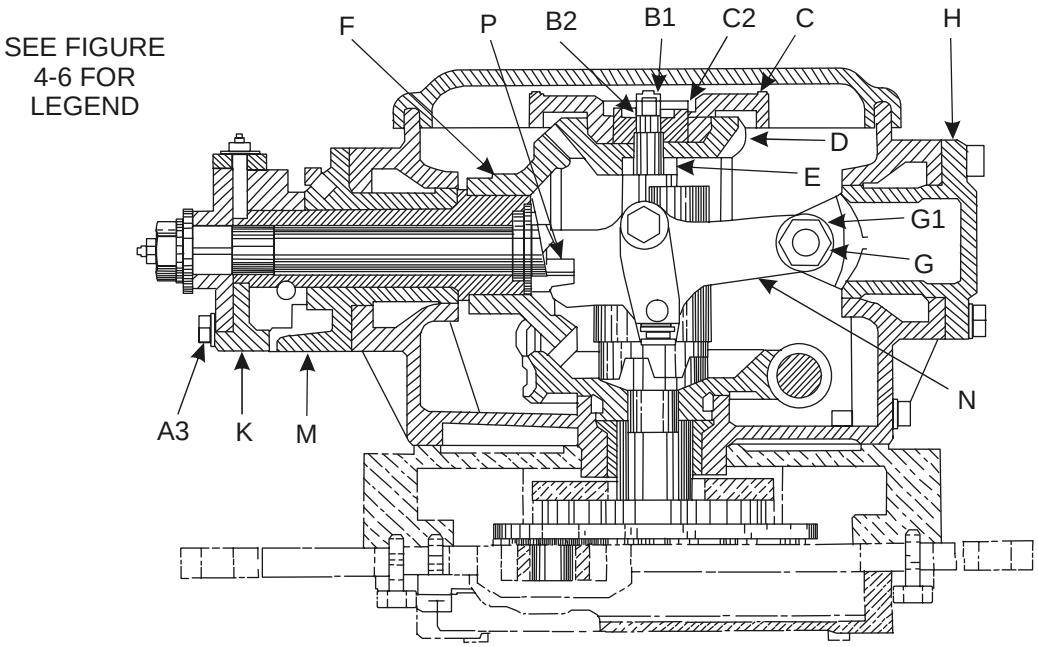


Figure 4-5. Sectional View of M-23 Gearbox – From Motor End (Right-Hand Assembly)

4. Remove the cotter pin at the top of the main crank. Remove the 1/2” castle nut (B1) and washer (B2) from the top of the main crank and lift the top bearing (C) from the dowel pins being careful not to bend the bearing plate.

NOTE

The rectangular key (C1) may come out with the top bearing. Check under the top bearing to see if the key has been removed and, if so, place the key in a safe spot for reinstallation.

5. Remove the rectangular key (C1) from the top bearing bushing (C2). Remove the top bearing bushing, the hand-throw pinion (D), and the spacing collar (E) from the top end of the crank.

6. Lift the hand-throw lever to the vertical position and loosen the set screw (F1) on the hand-throw bevel gear (F).

7. Remove the two 1/2-13 x 4-3/4” bolts (A3) and lock washers that secure the lever support (K) to the gearbox. Remove the two 1/2-13 x 1-1/2” bolts (A4) and washers that secure the lever shaft bearing (M) to the gearbox.

8. Holding the levers securely and guiding the shafts from the gearbox, carefully remove the lever assembly from the gearbox. Hold the hand throw bevel gear so that as the lever shafts are removed, the bevel gear doesn’t fall onto the bottom of the gearbox.

CAUTION

Removal of the lever assembly requires two persons to perform the procedure; one to remove the lever assembly and one to hold the hand throw bevel gear to prevent it from falling into the gearbox as the lever assembly is removed.

NOTE

There is a paper gasket between the lever shaft bearing and the gearbox case. Check it after removal of the lever assembly. If it is torn, it must be replaced. If it is intact on one of the two mating surfaces, it may be reused.

LEGEND

FOR FIGS. 4-5 & 4-6

A1 - BOLT
A2 - BOLT
A3 - BOLT
A4 - BOLT
B1 - NUT
B2 - WASHER
C - BEARING
C1 - KEY
C2 - BEARING BUSHING
D - PINION
E - COLLAR
F - GEAR
F1 - SET SCREW
G - BOLT
G1 - YOKE BUSHING
H - YOKE SUPPORT
K - LEVER SUPPORT
M - BEARING
N - YOKE
P - PIN
R - FRICTION CLUTCH

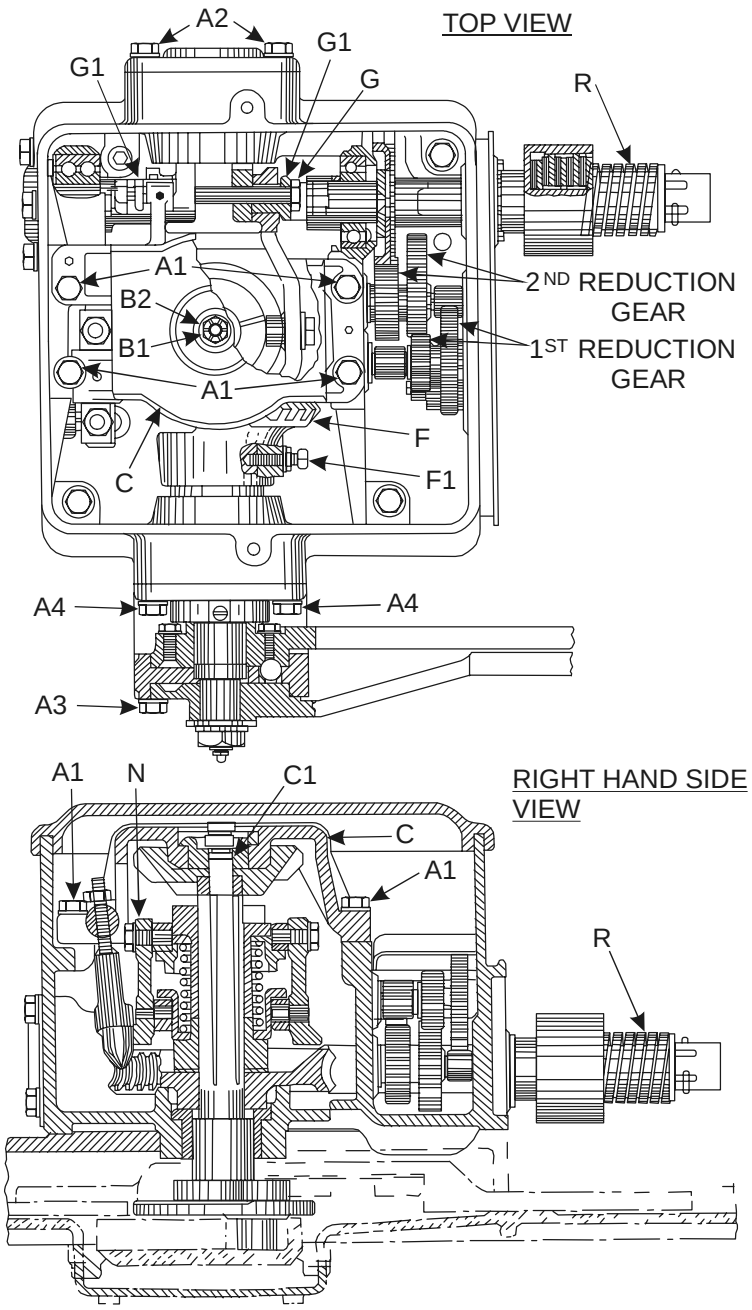


Figure 4-6. Sectional View of Gearbox Looking from Motor End

9. Lift the hand-throw bevel gear (F) from the gearbox.

10. Remove the 1/2-13 x 6" bolt (G), 1/2" nut, and two lock washers securing the yoke eccentric bushings (G1) to the yoke support (H). The positions of the eccentric bushings should be noted, and care should be taken to avoid changing their position when removing the bolt.

11. Remove the four 1/2-13 x 1-1/2" bolts and lock washers which secure the yoke support (H) to the gearbox and remove the yoke support.

NOTE

There is a paper gasket between the lever shaft bearing and the gearbox case. Check it after removal of the lever assembly. If it is torn, it must be replaced. If it is intact on one of the two mating surfaces, it may be reused.

4.8.1.2. Reassembling

1. With the gearbox disassembled per Section 4.8.1.1, grasp the yoke (N) firmly and, lifting upward, rotate the yoke 180º. Be sure the yoke assembly seats firmly on the main shaft after it is moved.

2. Transfer the yoke support (H) to the other side of the gearbox. Insert it into the gearbox and secure it with the four 1/2-13 x 1-1/2" bolts and lock washers removed in Step 11 of Section 4.8.1.1. When inserting the yoke support into the gearbox, be careful not to disturb the position of the eccentric bushings.

NOTE

There is a paper gasket between the lever shaft bearing and the gearbox case. Check it after removal of the lever assembly. If it is torn, it must be replaced. If it is intact on one of the two mating surfaces, it may be reused.

3. Secure the yoke to the yoke support using the 1/2-13 x 6" bolt (G), 1/2" nut, and two lock washers removed in Step 10 of Section 4.8.1.1.

4. Insert the lever assembly into the hub on the opposite side of the gearbox. As the shaft enters the gearbox, position the hand-throw bevel gear (F) so that the gear slides onto the keyed shaft. Position eccentric pin (P) on the selector shaft of the lever assembly so that it enters the slot on the end of the yoke. Ensure the gear is firmly against its seat on the shaft.

CAUTION

Insertion of the lever assembly requires two persons to perform the procedure; one to insert the lever assembly and one hold and guide the hand throw bevel gear onto the lever assembly shaft.

5. With the hand-throw lever vertical, and the bevel gear firmly seated against the lever shaft, tighten the set screw (F1) in the hand-throw bevel gear (F).

6. Secure the lever shaft bearing (M) to the gearbox with the two 1/2-13 x 1-1/2" bolts (A4) and washers removed in Step 7 of Section 4.8.1.1.

7. In order that the motor position of the selector lever will be toward the motor end of the machine (as indicated for standard assemblies in Diagrams A, B, C, or D Figure 4-7), the selector lever and lever interlock must be reassembled 180º from the original position on the shaft, as follows:

   a. Remove the 7/8" hex nut, lock washer, and flat washers from the end of the selector lever shaft and slide the selector lever and lever support (K) from the shaft. Be careful not to lose the steel ball in the lever support.

NOTE

If the stop screw is used in the hub instead of the hand-throw lever, it will be necessary to also remove this lever and interchange the stop screw and cap screw (refer to Figure 4-7). Replace the hand-throw lever and fasten it in place with the clamping bolt.

   b. Reassemble the lever support (K) with the hole for the steel ball on the motor side of the shaft. Insert the steel ball and reassemble the selector lever on the shaft so that the lever is 180º from its original position. (The stop screw, if used, may require positioning the hand-throw lever to align the recess with the hole in the lever support so that the steel ball will not interfere when the selector lever is applied.)

   c. Replace the hex nut and washers on the end of the shaft to hold the selector lever in place, then secure the lever support (K) with the two 1/2-13 x 4-3/4" bolts (A3) and lock washers removed in Step 7 of Section 4.8.1.1. These bolts also secure the bottom of the lever shaft bearing.

8. Move the selector lever to the Motor position (i.e., toward the motor end of the machine) and check to make sure that it moves the yoke (N) down.

9. Interchange the Motor and Hand nameplates on the selector lever to correspond with the new lever positions.

10. With the hand-throw lever vertical, place the collar (E) (with the chamfer down) on top of the main crank end. Install the hand-throw bevel pinion (D), engaging the tooth marked R (for right-hand assembly) or L (for left-hand assembly) with the punched marked master tooth space in the center of the hand-thrown bevel gear (F).

11. Carefully place the hand-throw lever in the Normal position. Be sure that the hand-throw bevel pinion (D) remains in the proper position relative to the hand-thrown bevel gear (F).

12. With the selector lever in the Motor position, rotate the friction clutch housing so that the motor clutch teeth are fully engaged.

13. Place the top bearing assembly (C) on the gearbox using the dowel pins as guides, and secure it with the four 1/2-13 hex head bolts (A1) and lock washers removed in Step 3 of Section 4.8.1.1. (The motor cutout push rod should be held back to clear the adjusting rod until bearing is down).

14. Install the top bearing bushing (C2), rectangular key (C1), washer (B2) on the top of the main crank. Tighten castle nut (B1) firmly, then back it off to the nearest cotter hole and insert a cotter pin after operating the machine manually with the hand throw lever to be sure that the mechanism does not bind. Flare the end of the cotter pin per usual installation practice.

15. Check the adjustment of the motor cutout push rod. Contacts should open when the end of the selector lever has been raised approximately 6" from the horizontal motor position.

16. Readjust both yoke eccentric bushings as described in Section 4.8.4, then secure it by tightening bolt (G) firmly.

17. Check that the machine can be operated by power and also that it shifts to hand-throw operation from both Normal and Reverse positions.

18. Check that all bolts are drawn down tightly on their lock washers and that all cotter pins are in place.

19. Replace the gearbox cover and secure it to the gearbox with the two 5/8-11 x 2” hex head bolts removed in Step 1 of Section 4.8.1.1.

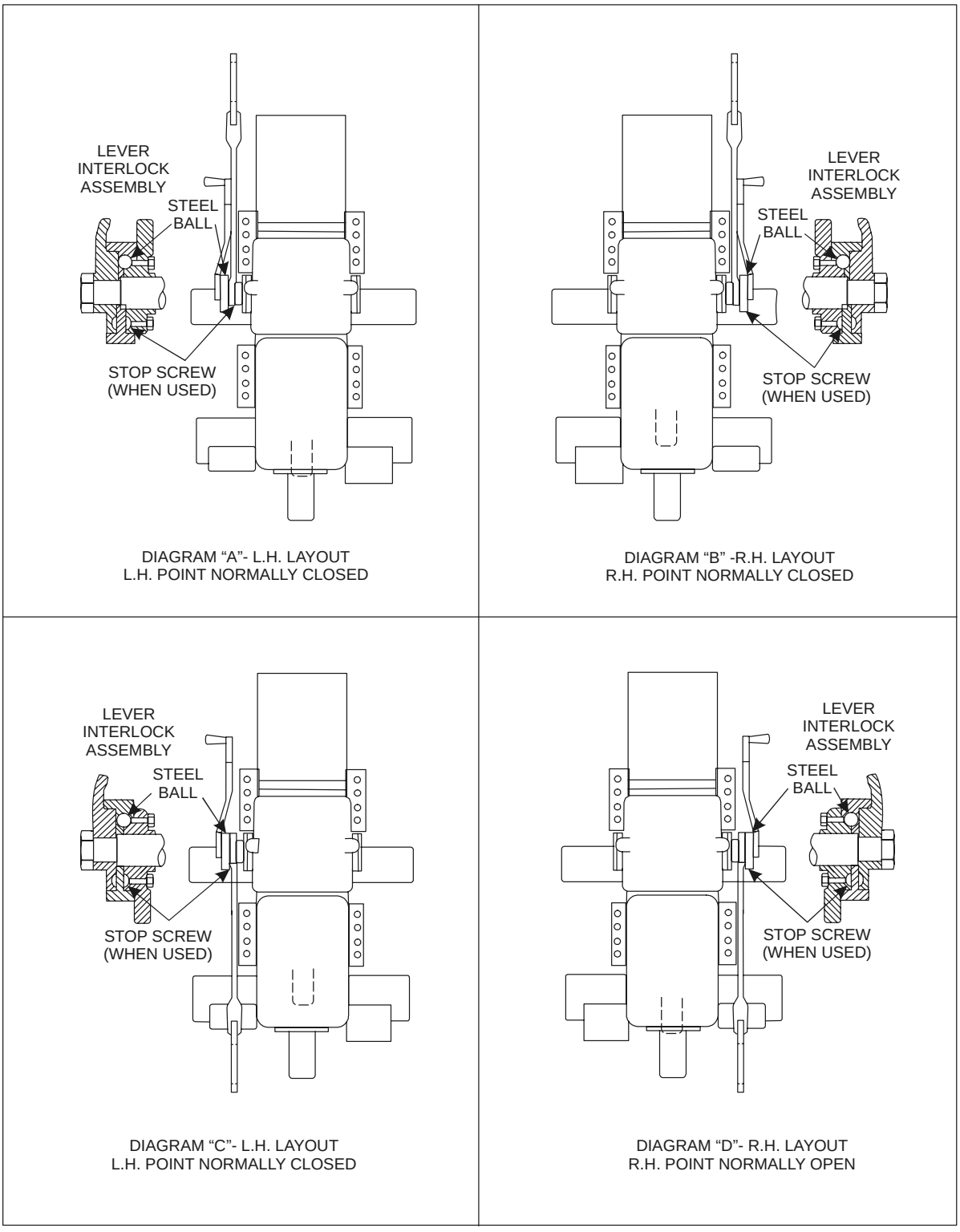


Figure 4-7. Standard Lever Interlock Assemblies for M-23 Switch Machine

4.8.2. Lever Assembly

For the removal and insertion of the lever assembly ASTS USA recommends that two men perform the procedure; one to insert the lever assembly and one to hold and guide the hand throw bevel gear onto the lever assembly shaft. If only one person is available, ASTS USA recommends dismantling the lever assembly to move it to the other side of the gearbox.

4.8.2.1. Disassembly

1. Remove the 7/8" hex nut, lock washer, and flat washers from the end of the selector lever shaft and slide the selector lever from the shaft. Be careful not to lose the steel ball in the lever support.

2. Lift the hand-throw lever to the vertical position and loosen the set screw (F1) on the hand-throw bevel gear (F). Remove the hand throw lever from the lever shaft.

3. Remove the two 1/2-13 x 4-3/4" bolts (A3) and lock washers that secure the lever support (K) to the gearbox and slide the lever support from the shaft. It may be necessary to lift on the yoke (N) to free the eccentric pin (P) on the selector shaft.

4. Remove the two 1/2-13 x 1-1/2" bolts (A4) and washers that secure the lever shaft bearing (M) to the gearbox.

5. Grasp the hand throw bevel gear and remove the shaft assembly from the gearbox case. The shaft will pull free of the bevel gear as it is pulled from the gearbox case. Be sure that the bevel gear does not fall into the case as the shaft is removed.

NOTE

There is a paper gasket between the lever shaft bearing and the gearbox case. Check it after removal of the lever assembly. If it is torn, it must be replaced. If it is intact on one of the two mating surfaces, it may be reused.

4.8.2.2. Reassembly

1. The lever assembly is to be installed on the opposite side of the gearbox case after the yoke support has been removed.

2. Place the bevel gear inside the gearbox case on the side where the lever shaft will be installed.

3. Insert the lever shaft into the opening on the gearbox case. As the shaft enters the case, position the bevel gear so that the shaft slides through the center of the bevel gear and that the keyways match. It may be necessary to lift the yoke a bit to facilitate the eccentric pin (P) on the lever shaft assembly entering the slot on the end of the yoke.

NOTE

A paper gasket is located between the lever shaft bearing and the gearbox case. Check it after removal of the lever assembly. If it is torn, it must be replaced. If it is intact on one of the two mating surfaces, it may be reused.

4. Secure the lever shaft bearing (M) to the gearbox case using the two 1/2-13 x 1-1/2" bolts (A4) that were removed in Step 4 of Section 4.8.2.1.

5. Put the hand throw lever on the lever shaft. The lever is keyed to the shaft and can be put on in either direction. Be sure it is positioned on the shaft so that it moves in the proper direction.

6. Slide the lever support (K) onto the lever shaft. Secure it to the gearbox case with the two 1/2-13 x 4-3/4" bolts (A3) and lock washers removed in Step 3 of Section 4.8.2.1.

7. Put the selector lever onto the lever shaft. The lever is keyed to the shaft and can be put on in either direction. Be sure it is positioned on the shaft so that it moves in the proper direction.

8. Secure the selector lever to the shaft with the 7/8" hex nut, lock washer, and flat washers removed in Step 1 of Section 4.8.2.1.

4.8.3. Other Mechanical Changes

4.8.3.1. Operating Bar

1. Remove the two operating bar covers from either side of the switch machine by removing the 1/2" bolts and washers that secure it to the machine. These have to be installed on the other side of the switch machine when the lug is installed.

2. Remove the cotter pin, the 7/8" nut, washer, and 7/8-9 hex head bolt which secure the operating bar lug to the operating bar.

3. Remove the operating bar lug and place it on the operating bar on the other side of the switch machine.

4. Secure the operating bar lug with the cotter pin, the 7/8" nut, washer, and 7/8-9 hex head bolt removed in Step 2.

5. Install the operating bar covers on the sides of the switch machine. One of the covers is designed to fit over the operating bar lug and can only be installed over the lug. Secure the covers with the 1/2" bolts and washers removed in Step 1.

4.8.4. Selector Clutch Adjustment

Selector clutch adjustment should be checked annually. When the selector lever is in the Motor position and the selector clutch teeth are in full engagement with the teeth on top of the worm gear so the motor drives the crank, the top rollers on the operating yoke should be just clear of the upper spring cup.

This relation can be varied by adjusting the eccentric bushings (G1). As shown in Figure 4-5 and Figure 4-6, the selector clutch yoke has one end supported on and driven by the finger on the selector lever shaft, and its other end pivots on the eccentric bushings that are fixed by G. When this bolt is loosened, the eccentric bushings may be rotated to raise or lower the center line for the pivot holes in the yoke arms, affecting the elevation of the yoke rollers.

The eccentric bushings have hexagonal heads; one flat is stenciled “N” and the flats on either side of the “N” flat are marked “+” and “-”. The “N” will be on top when the eccentric bearing is in its mean position. When the eccentric bushings are turned to bring the “+” mark up, the yoke and its rollers will lift. Alternately when the “-“ mark is up, the yoke and its rollers are lowered. To avoid twisting the yoke, these marks should be kept turned to a like degree “+” or “-”.

Tightening bolt G holds the adjustment of the eccentric bearings. When it is necessary to adjust the eccentric bushings, check that the top rollers are free from the bearing on the upper spring cup while the selector clutch is fully down, and in addition, check that the rollers are not too high as follows:

1. Place the selector lever in the Motor position when the worm gear is not in position to receive the selector clutch, so that the teeth of “Clutch for Motor Operation,” (Figure 4-8), ride on top of the corresponding teeth of the worm gear.

2. Insert a 1/8” length of a #14 soft copper wire between the opposed teeth. The eccentric bushings should be adjusted the same degree “+” or “-” so that (with the bolt tight) the force between the opposed teeth will crush the wire to not more than 1/32” thick when the selector lever is thrown to the horizontal position for motor operation.

3. Check that the upper rollers are free to turn when the selector clutch is fully engaged with the worm gear.

4.8.5. Jumper Configuration Changeover

When the switch machine is converted from right to left-hand operation, the RHPC/LHPC jumper has to be inserted in the proper location on the junction board in the Junction Box. (Refer to Section 4.1.3 for this procedure.

4.9. Final Inspection and Testing after Installation

WARNING

To avoid severe personal injury, open the gold nut test link in the motor compartment prior to performing any internal machine maintenance. Always keep hands and feet clear of switch points and the internal moving parts of the machine Ensure that loose clothing is properly secured prior to working on the switch machine.

1. Ensure that all switch connecting rods are square to the switch point prior to fastening the switch mechanism to the ties.

2. Ensure that all rods operate without binding and properly clear the base of the stock rail.

3. Nothing is gained by excessive point pressure. Adjust the switch adjust (basket) until the switch points just close in either position.

4. Ensure the switch machine is installed per the applicable installation drawings and that all fasteners are properly secured.

5. Final adjustment of the lock rods and point detector system should be performed in accordance with standard railroad operating practices, AREMA recommended practices, and FRA Rules and Regulations.

6. Independent breakdown testing of the switch machine circuitry should be performed in accordance with standard railroad operating practices, AREMA recommended practices, and FRA Rules and Regulations.

7. If the machine is equipped with a local/remote feature, ensure the local/remote toggle switch is in the “Remote” position prior to leaving the installation site.

8. Ensure all covers are properly installed and locked prior to leaving the installation site.

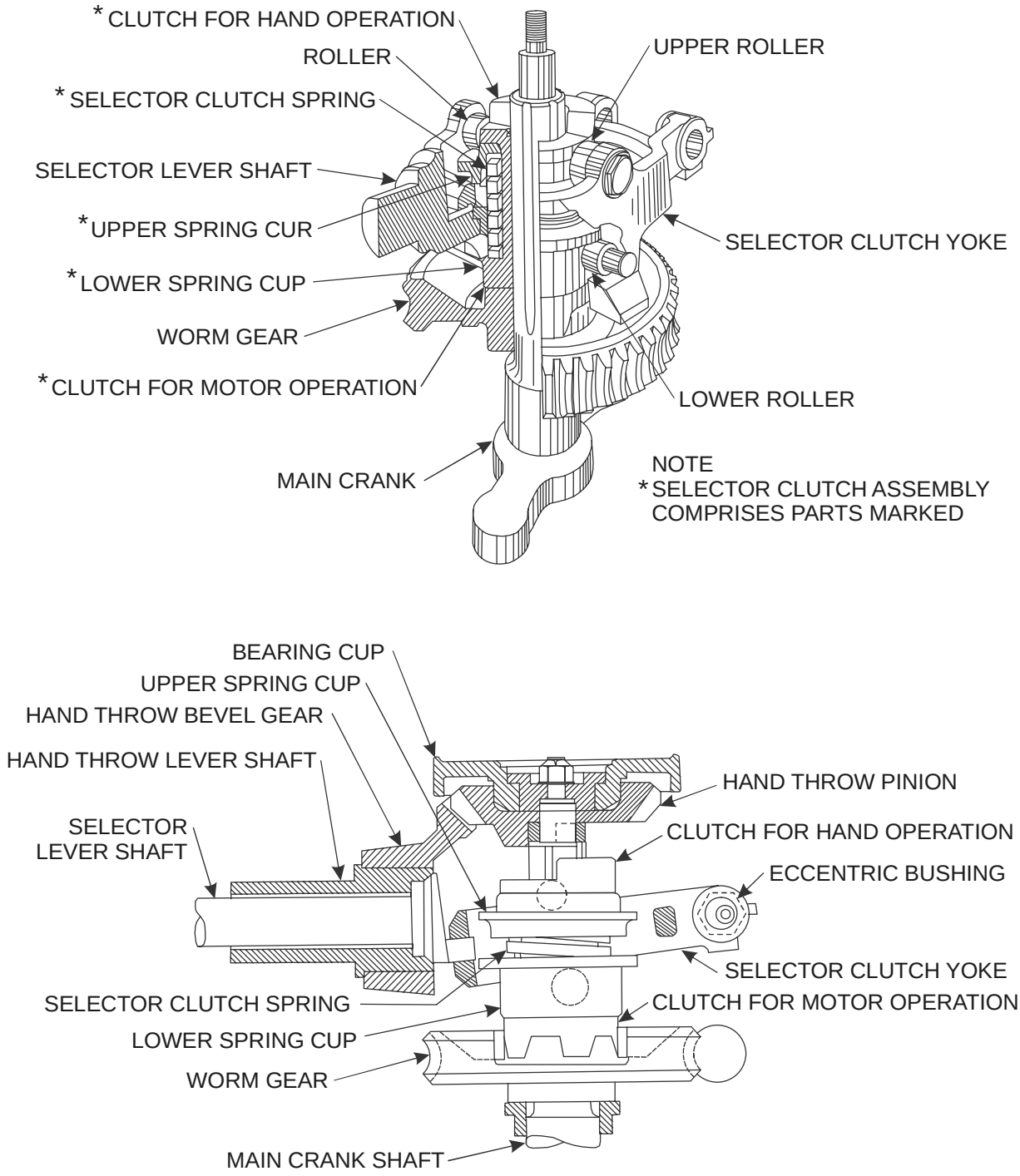


Figure 4-8. Sectional Views of M-23 Dual Control Mechanism

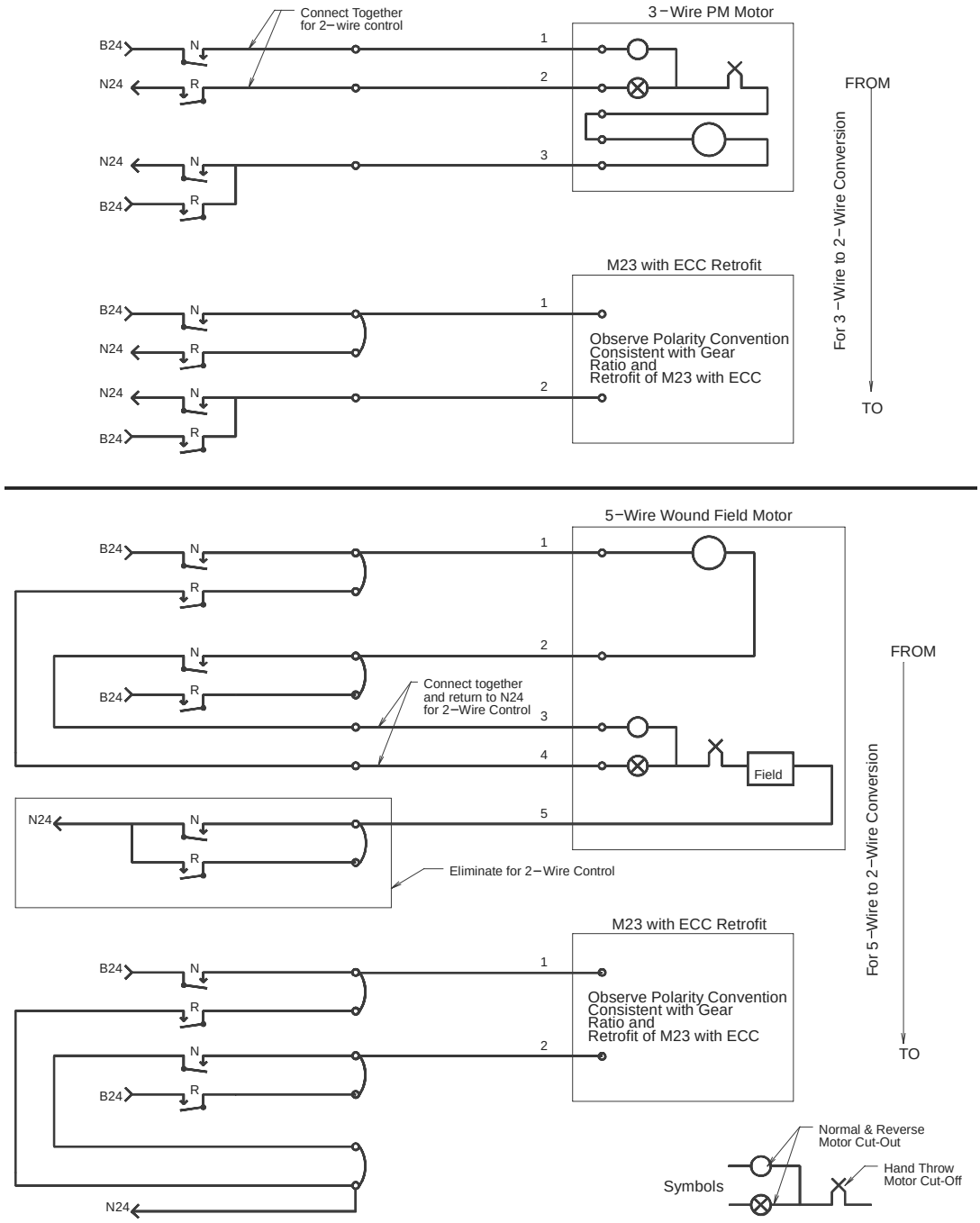
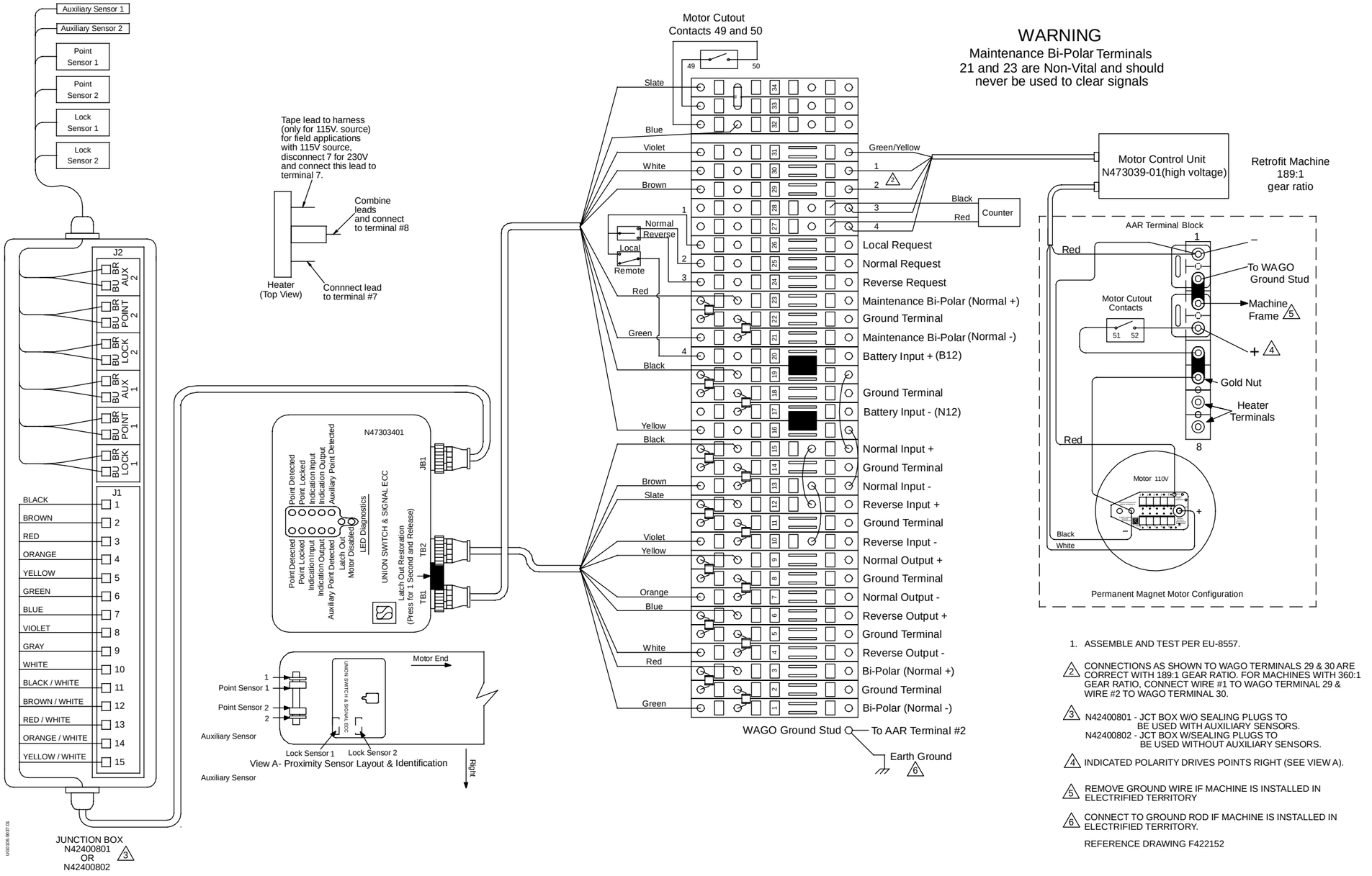


Figure 4-9. Wiring Changes from 3-Wire and 5-Wire to 2-Wire Motor Control



1. ASSEMBLE AND TEST PER EU-8557.

2 CONNECTIONS AS SHOWN TO WAGO TERMINALS 29 & 30 ARE CORRECT WITH 189:1 GEAR RATIO. FOR MACHINES WITH 360:1 GEAR RATIO, CONNECT WIRE #1 TO WAGO TERMINAL 29 & WIRE #2 TO WAGO TERMINAL 30.

3 N42400801 - JCT BOX W/O SEALING PLUGS TO BE USED WITH AUXILIARY SENSORS.
N42400802 - JCT BOX W/SEALING PLUGS TO BE USED WITHOUT AUXILIARY SENSORS.

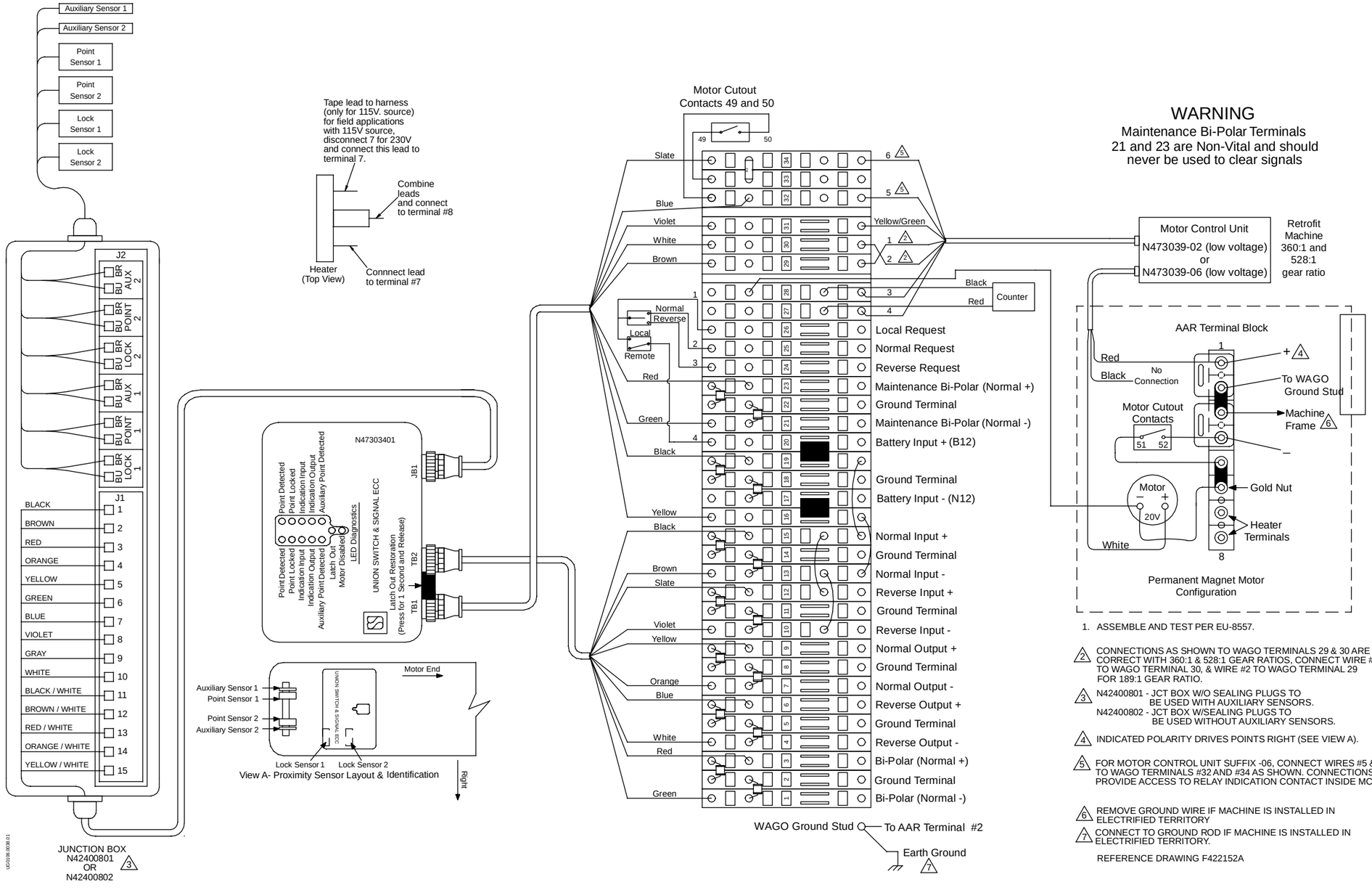
4 INDICATED POLARITY DRIVES POINTS RIGHT (SEE VIEW A).

5 REMOVE GROUND WIRE IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY

6 CONNECT TO GROUND ROD IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY.

REFERENCE DRAWING F422152

Figure 4-10. Internal Wiring Diagram (High Voltage)



1. ASSEMBLE AND TEST PER EU-8557.

2. CONNECTIONS AS SHOWN TO WAGO TERMINALS 29 & 30 ARE CORRECT WITH 360:1 & 528:1 GEAR RATIOS, CONNECT WIRE #1 TO WAGO TERMINAL 30, & WIRE #2 TO WAGO TERMINAL 29 FOR 189:1 GEAR RATIO.

3. N42400801 - JCT BOX W/O SEALING PLUGS TO BE USED WITH AUXILIARY SENSORS.
   N42400802 - JCT BOX W/SEALING PLUGS TO BE USED WITHOUT AUXILIARY SENSORS.

4. INDICATED POLARITY DRIVES POINTS RIGHT (SEE VIEW A).

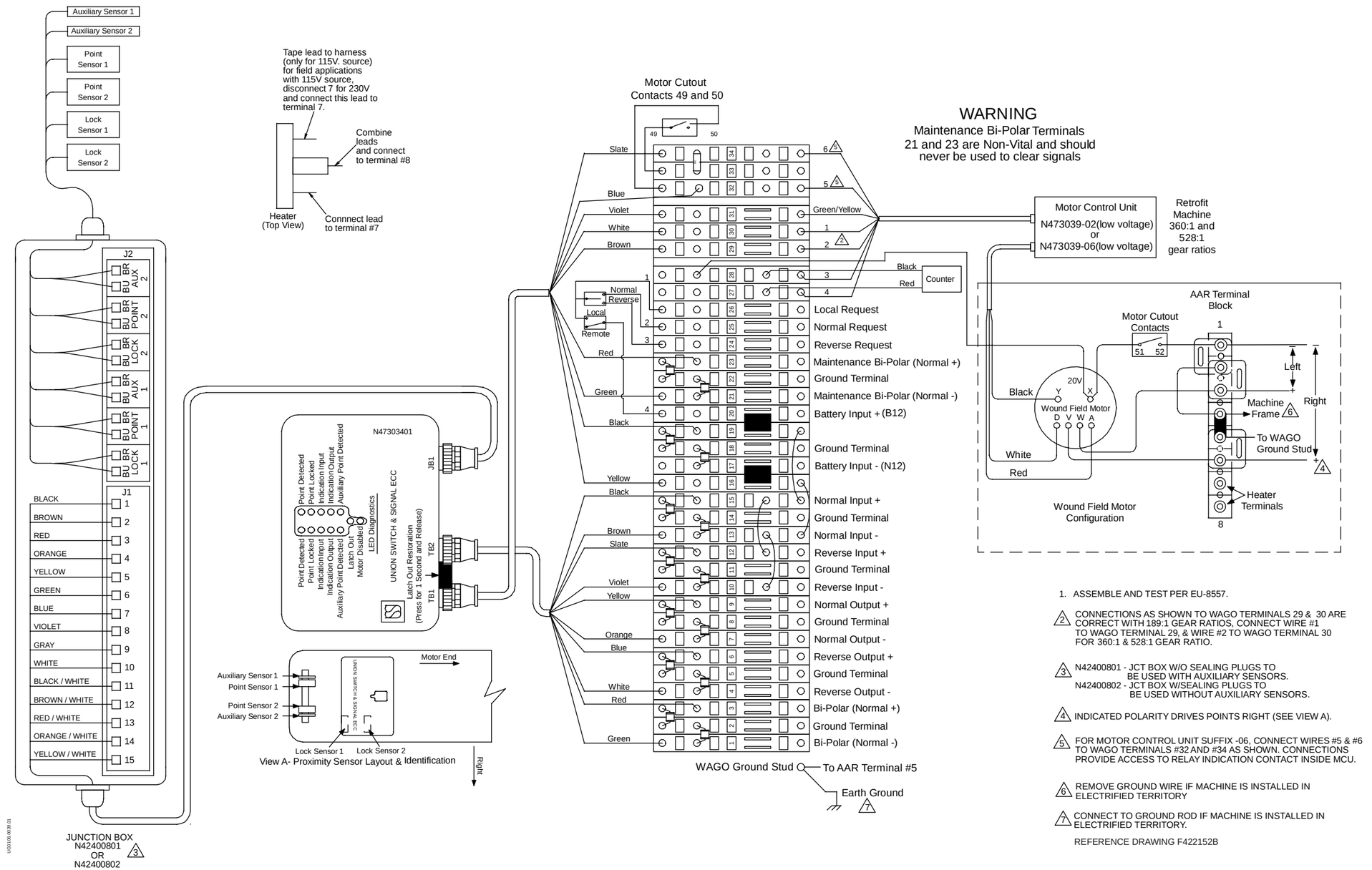
5. FOR MOTOR CONTROL UNIT SUFFIX -06, CONNECT WIRES #5 & #6 TO WAGO TERMINALS #32 AND #34 AS SHOWN. CONNECTIONS PROVIDE ACCESS TO RELAY INDICATION CONTACT INSIDE MCU.

6. REMOVE GROUND WIRE IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY

7. CONNECT TO GROUND ROD IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY.

REFERENCE DRAWING F422152A

Figure 4-11. Internal Wiring Diagram (Low Voltage Control Unit with Permanent Magnet Motor)



1. ASSEMBLE AND TEST PER EU-8557.

2. CONNECTIONS AS SHOWN TO WAGO TERMINALS 29 & 30 ARE CORRECT WITH 189:1 GEAR RATIOS, CONNECT WIRE #1 TO WAGO TERMINAL 29, & WIRE #2 TO WAGO TERMINAL 30 FOR 360:1 & 528:1 GEAR RATIO.

3. N42400801 - JCT BOX W/O SEALING PLUGS TO BE USED WITH AUXILIARY SENSORS.
N42400802 - JCT BOX W/SEALING PLUGS TO BE USED WITHOUT AUXILIARY SENSORS.

4. INDICATED POLARITY DRIVES POINTS RIGHT (SEE VIEW A).

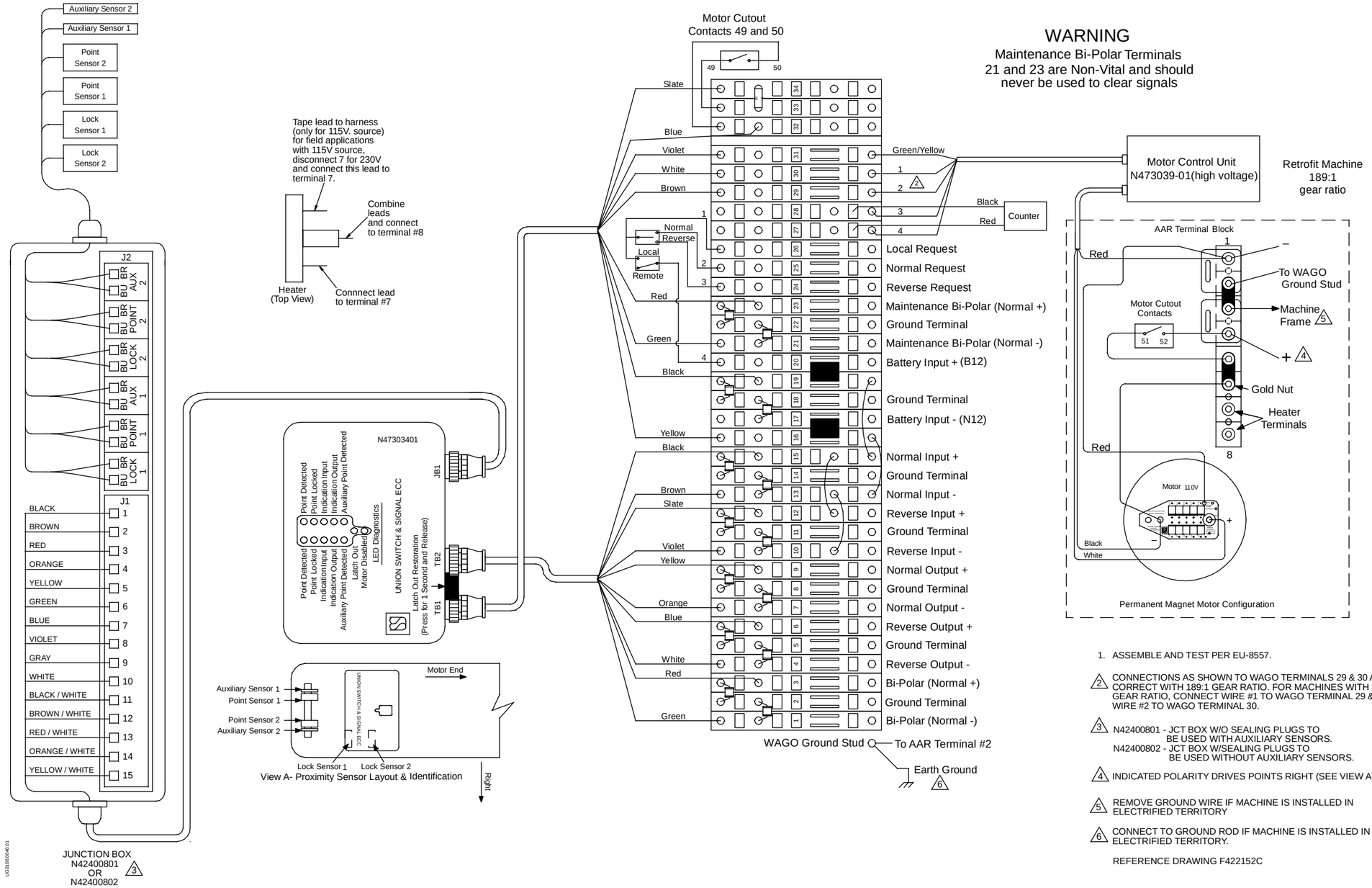
5. FOR MOTOR CONTROL UNIT SUFFIX -06, CONNECT WIRES #5 & #6 TO WAGO TERMINALS #32 AND #34 AS SHOWN. CONNECTIONS PROVIDE ACCESS TO RELAY INDICATION CONTACT INSIDE MCU.

6. REMOVE GROUND WIRE IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY

7. CONNECT TO GROUND ROD IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY.

REFERENCE DRAWING F422152B

Figure 4-12. Internal Wiring Diagram (Low Voltage Control Unit with Wound Field Motor)



1. ASSEMBLE AND TEST PER EU-8557.

2. CONNECTIONS AS SHOWN TO WAGO TERMINALS 29 & 30 ARE CORRECT WITH 189:1 GEAR RATIO. FOR MACHINES WITH 360:1 GEAR RATIO, CONNECT WIRE #1 TO WAGO TERMINAL 29 & WIRE #2 TO WAGO TERMINAL 30.

3. N42400801 - JCT BOX W/O SEALING PLUGS TO BE USED WITH AUXILIARY SENSORS.
   N42400802 - JCT BOX W/SEALING PLUGS TO BE USED WITHOUT AUXILIARY SENSORS.

4. INDICATED POLARITY DRIVES POINTS RIGHT (SEE VIEW A).

5. REMOVE GROUND WIRE IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY

6. CONNECT TO GROUND ROD IF MACHINE IS INSTALLED IN ELECTRIFIED TERRITORY.

   REFERENCE DRAWING F422152C

Figure 4-13. Internal Wiring Diagram (High Voltage, Derail Machine)

5. TROUBLESHOOTING

Table 5-1 is a troubleshooting matrix that covers ECC failure modes (problems), the possible cause(s) of the problem, and the possible solutions to the problem.

To use the troubleshooting table, identify the problem being experienced from the left-hand "problem" category column. The possible "causes" of the problem are listed in the center column and the possible "solutions" to the problem are in the right column of the table.

Table 5-1. ECC Troubleshooting

Problem	Cause	Solution
1. Motor power is present from the wayside but motor does not run.	A. MCU wired incorrectly.	1. Confirm proper connections of MCU wires 1 and 2 in WAGO Terminals 29 and 30 per the internal wiring diagram shown in Figure 4-10, Figure 4-11, and Figure 4-12.
		2. Check terminations of white, black, and red MCU wires on AAR terminal posts.
	B. Motor is DISABLED by ECC (Red Motor Disabled LED is ON).	1. In M-23 with ECC, ensure motor cutout proximity sensors in gearbox and on transmission box are adjusted properly and *both* indicate ON by the illumination of the sensor's yellow LED.
		2. In an M-23 switch machine equipped with an ECC, ensure two wires connecting motor cutout contact to WAGO terminal strip are connected properly and that the 750-ohm resistor is properly installed between WAGO Terminals 33 and 34.
	C. Gold Nut circuit link on AAR terminal posts is open.	1. Ensure that the Gold Nut connection is closed and properly secured with an AAR jam nut.
2. Motor runs but not in proper direction (causing friction clutch to slip).	A. Incorrect motor polarity.	1. Reverse motor wires on motor terminals (not on AAR terminal posts).
3. A single dual-colored LED is flashing RED.	A. Corresponding sensor wire is shorted, open, or not properly connected.	1. Ensure proper termination of the brown and blue sensor wires to the corresponding spring terminals in the Junction Box (terminals are labeled on the PC board BR for brown and BL for blue).
	B. Sensor is adjusted marginally (between ON and OFF) with respect to it's target.	1. For point detection sensors - adjust the linear sensor location away from the ON/OFF threshold as described in the Initial Setup section of the corresponding product service manual.
		2. For locking sensors - ensure that the machine is in the fully locked position and the machine has completed its stroke. Note – linear position of the locking sensors is not adjustable.
4. Latch-out LED is Flashing RED.	A. Missing configuration jumper.	1. Ensure that the configuration jumper is installed in latch-out jumper slots in Junction Box.
5. All four dual-colored LEDs are flashing RED.	A. Incorrect configuration jumper installation in junction box.	1. Ensure that one jumper is installed in the latch-out jumper slots and one jumper is installed in the LHPC/RHPC jumper slots. The ECC will not work if either jumper is absent or if multiple jumpers are installed in any one configuration.

Problem	Cause	Solution
	B. Junction box cable JB1 is not properly connected to ECC box.	1. Ensure JB1 cable keys are aligned properly, the connector is fully inserted and the locking ring is turned clockwise until it locks in place.
6. All LEDs on the ECC drop out and the controller may or may not reset.	A Insufficient/low battery feed level to the ECC.	Ensure a continuous battery feed of at least 10 VDC (with proper polarity) is present on WAGO Terminals 17 (N12) and 20 (B12). Ensure all wires on cables TB1 and TB2 are properly terminated on the WAGO terminal strip and that the cable plug connectors are properly secured to the ECC box.
	Resistor may be in series with the battery supply voltage.	Bypass the resistor so that the ECC gets the proper in-line voltage.
7. All diagnostic LEDs are properly lit on the ECC (a continuous vertical row of GREEN LEDs is observed) yet no Indication Output is present on WAGO terminal strip (no voltage is present between Terminals 1 and 3).	A. Cable TB2 is improperly connected, terminated, or is defective.	1. Ensure TB2 plug connector is properly secured and locked to the ECC box. Ensure all 10 color-coded wires are properly terminated on the WAGO terminal strip and that all crimped wire ferrules are properly secured to the end of each wire.
	B. Defective ECC or improper software execution by the ECC processor.	1. Remove cable TB1 and reconnect, initiating an ECC processor reset. If the unit resets and the LEDs restore, re-check for presence of voltage output on WAGO Terminals 1 and 3.
		2. Even if output restores, replace the ECC box as an entire unit and return to ASTS USA for analysis.
8. Sensors do not turn ON when target or lock box is in front of more than 50% of the sensor face.	A. Sensor not properly connected to junction box.	1. Ensure proper termination of the brown and blue sensor wires to the corresponding terminals in the Junction Box (terminals are labeled on the PC board BR for brown and BL for blue).
	B. Sensor air gap not properly adjusted.	1. For vital (large diameter) sensors, ensure gap between sensor face and PD target/lock box is adjusted to 0.075" and the gap from the sensor to the lock box target is 0.075".
		2. For auxiliary (non-vital - small diameter) sensors, ensure that the air gap between sensor face and target is adjusted to 0.040".
9. Point Detected and Point Locked LEDs are GREEN but Indication Output LED is dark.	A. Indication Input is not energized.	1. Ensure Indication Input voltage (with proper polarity) is present on WAGO Terminals 13 and 15 for Normal and Terminals 10 and 12 for Reverse. Voltage should be obtained from an adjacent machine or jumper connected per Section 4 of this manual.
	B. The ECC is in a latched-out state.	1. Reset the latch-out by depressing the latch-out restoration button on the front of the ECC, holding for one second and releasing.
	C. Motor is DISABLED by ECC (Red Motor Disabled LED is ON).	1. In M-23 with ECC, rotate the selector lever to the Motor position. The light should go dark on the motor cutout and the indication output LED should come on.
	D. Point and/or Locking sensor for *opposite* switch machine position are ON.	1. In an M-23 equipped with an ECC, ensure the two wires connecting motor cutout contact to WAGO terminal strip are connected properly and that the 750-ohm resistor is properly installed between WAGO Terminals 33 and 34.

Problem	Cause	Solution
		2. Verify proper linear adjustment of the PD sensor and verify proper 0.075" vital sensor air gap to obtain proper sensor response. Remove any loose, metallic objects or obstructions from the vicinity of the sensors.
		3. Ensure that LS1 and PS1 and LS2 and PS2 are terminated correctly in the Junction Box. They must work as a unit.
10. The ECC does not latch-out when point detector target is removed from in front of target face and restored.	A. Machine is not fully locked.	1. Ensure machine is fully locked. A latched out condition will only occur if the machine is fully locked and the switch point moves away from the stock rail.
	B. ECC is configured to disable the latch-out feature.	1. Move latch-out configuration jumper in the junction box from the disable to the manual or automatic jumper positions.
	C. Point detected and point locked sensors for that corresponding position are not ON, (i.e., the machine is not fully thrown and locked or the PD sensors are out of adjustment.	1. Ensure proper linear adjustment of the PD sensors to indicate the presence of the point detector bar target and ensure that the machine is in the full locked position prior to restoring the latched-out condition.
	D. Defective latch-out restoration pushbutton on ECC.	1. To verify, move latch-out configuration jumper to the automatic position in the junction box and manually cycle the machine to the opposite position and back.
		2. If the latched-out condition restores the pushbutton is defective, replace the ECC unit at your earliest convenience and return to ASTS USA for repair.
		3. If the latched-out condition does not restore and all vital sensors are properly functioning, replace the ECC unit and return to ASTS USA for repair.

6. PARTS LIST

Table 6-1. Various Available ECC Configurations

Part Number	Description
N42252901	M-23 – M-3 w/ECC without Auxiliary Sensors
N42252902	M-23 – M-3 w/ECC with Auxiliary Sensors
N42252903	M-23 – M-3 w/ECC without Auxiliary Sensors, without Local Remote Switch
N42252904	M-23 – M-3 w/ECC with Auxiliary Sensors, without Local Remote Switch

6.1. Circuit Controller Compartment

Table 6-2 list the parts of the circuit controller compartment and Figure 6-1 shows the parts location.

Table 6-2. Parts List for the Circuit Controller Compartment

Item No.	Description	ASTS USA Part No.
5	ECC Assembly w/o Aux Sensor	N42252901
	ECC Assembly w Aux Sensor	N42252902
10	Target	M42322803
15	Point Detector Bar, Clevis Style	M42373201
20	Point Detector Bar, Threaded	M42371701
25	Screw, 1/4-20 x ¾", Skt Cap	J5001240158
30	Set Screw, 1/2-20 x 1/2", Cup Point	J5001240149
35	Point detector Bushing	M42370901
40	Screw, Flat Head, 1/2-13 x 1.5"	J5001240164
50	Rotational Stop Block	M42371401
55	Screw, 3/8-16 x 1/4", Hex Hd	J507372
60	Washer, Lock, 3/8 Steel	J047768
65	Lock Box Target	M42370502
70	Screw, 1/4-20 x 1.5" , Skt Cap	J5001240163
75	Spring, Pin 3/16" Dia., 1.5" L	J0680140009
80	Washer, Lock, No. 1/4, SS	J4751210111
85	HRNSS, M-23 Upgrade SM, 5-key, TB1	N42215103
90	HRNSS, M-23 Upgrade SM, 4-key, TB2	N42215104

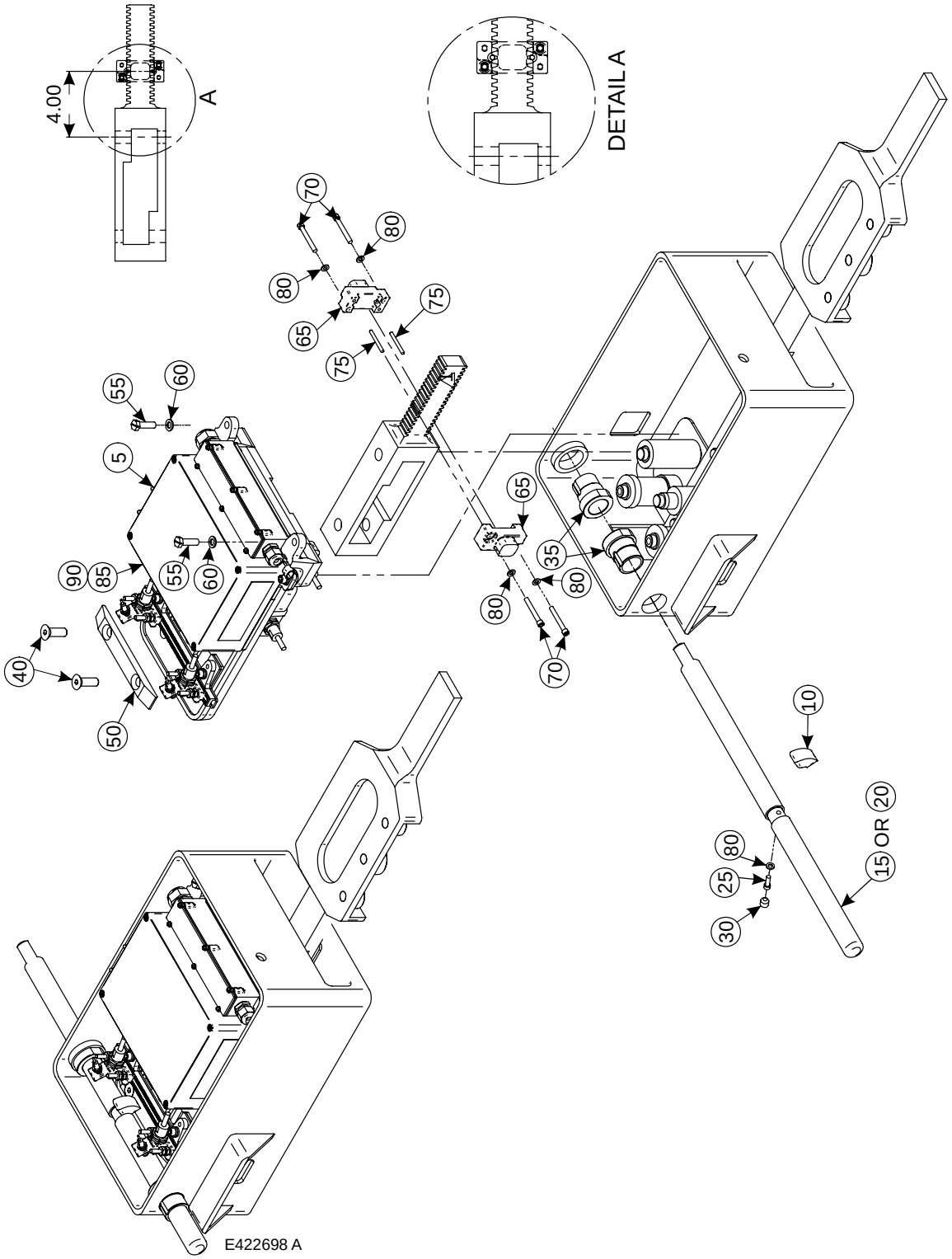


Figure 6-1. Circuit Controller Compartment

6.2. Circuit Controller ECC Assembly (N422529-XX)

Table 6-3 lists the parts of the circuit controller ECC assembly and Figure 6-2 shows the parts location.

Table 6-3. Parts List for the Circuit Controller Assembly (N422529-XX)

Item No.	Description	ASTS USA Part No.
1	Controller Frame	M42370002
2	Lock Box Sensor Bracket	M-2370602
3	Lock Sensor (LS1)	N42307001
4	Lock Washer, M18	J4751210138
5	Dowel Pin, 3/8” x 3/4”	J0487220009
6	Screw, Head Cap, 3/8”-16 x 1”	J5001240141
7	Washer 3/8” Lock	J047779
8	Junction Box Assembly (M-23 Upgrade with Plugs)	N42252701
9	Not Used	NA
10	Washer, Spring Lock, 5/16”	J4751380112
11	Harness Clamp	J703005
12	Point Detector Sensor Assembly with Auxiliary Sensors	N42252401
13	Pin, 1” x 0.250” dia.	M42371801
14	Sensor Bracket Insulator	M42370301
15*	Local/Remote Switch Assembly (M-23 Upgrade)	N42252801
16 – 19	Not Used	NA
20*	Screw, Skt Cap, 1/4”-20 x 3/4”	J5001240158
21*	High Collar Lock Washer, 1/4”	J047521
22	Screw, Skt Head Cap, 5/16”-18 x 1	J5001240153
23 –24	Not Used	NA
25	ECC Box Upgrade Assembly	N42252101
26	Lock Sensor (LS2)	N42307002

* When Used

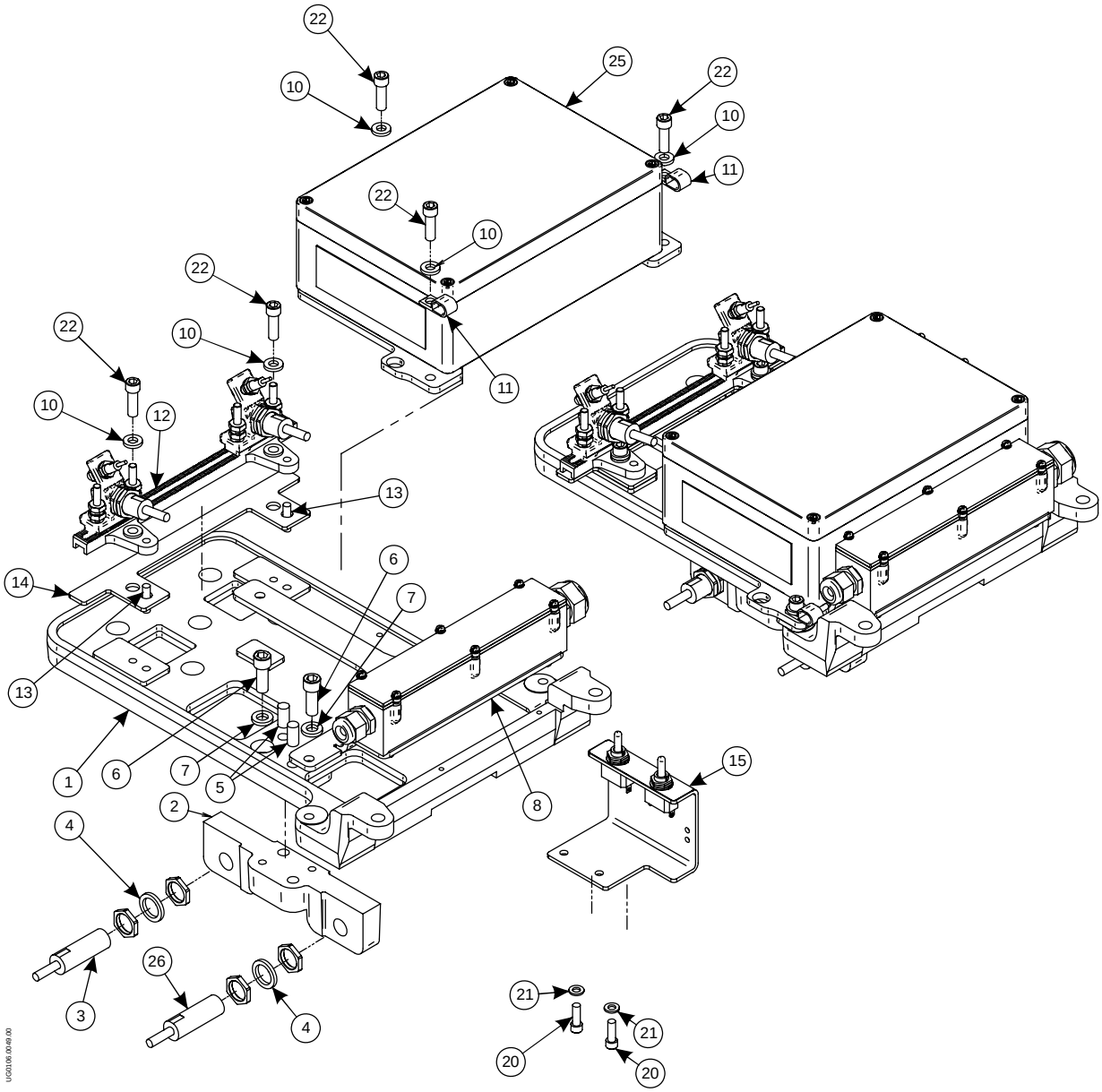


Figure 6-2. Circuit Controller ECC Assembly

6.3. Junction Box Assembly (N42252701)

Table 6-4 lists the parts of the junction box assembly and Figure 6-3 shows the parts location.

Table 6-4. Parts List for the Junction Box Assembly

Item No.	Description	ASTS USA Part No.
1	Junction Box - M-23/M-3 Upgrade	M42372402
2	Switch Machine Junction Box PCB	N49702701
3	Seal Ring, Altech PG21-PE	J7002160012
4	Strain Relief, PG21, Black	J7002160014
5	OVC Multi-conductor Insert	J7002160016
6	Locknut, PG-21, 32 mm wide	J7002160011
7	Strain Relief, PG13.5, Black	J7002160015
8	Seal Ring, Altech PG13.5-PE	J7002160013
9	Locknut, Nickel Plated Brass	J7002160006
10	Screw, 6-32 x 5/16, Pan Head SS	J5072980105
11	Harness, M-23 Upgrade, J-Box	N42400202
12	Washer, No. 6, Lock SS	J4751200156
13	Nameplate	M21036902
14 – 15	Not Used	NA
16	Screw, 6-32 x 5/8" Pan Head	O0135331
17	Washer, Nylon 6/6 Retaining, No. 4	J4751200170
18	Gasket, M-23 Upgrade J-Box	M42372601
19	Cover, M-23 Upgrade J-Box	M42372701
20	Not Used	NA
21	Washer, 0.144 ID Flat SS	J4751210128
22	Screw, 4-40 x 5/16, Pan Head SS	J5072970105
23	Washer, No. 4 Flat SS	J4751200106
24	Washer, No. 4, Split Lock	00335025

The wiring chart for connecting the wiring harness (Item 11) to the PCB (Item 2) is given in Table 6-5.

Table 6-5. Wiring Chart for the Junction Box Assembly Harness

Wire Color (from Harness)	To J1 Connector on the J-Box PCB
Black	J1-1
Brown	J1-2
Red	J1-3
Orange	J1-4
Yellow	J1-5
Green	J1-6
Blue	J1-7
Violet	J1-8
Gray	J1-9
White	J1-10
Black/White	J1-11
Brown/White	J1-12
Red/white	J1-13
Orange/White	J1-14
Yellow/white	J1-15

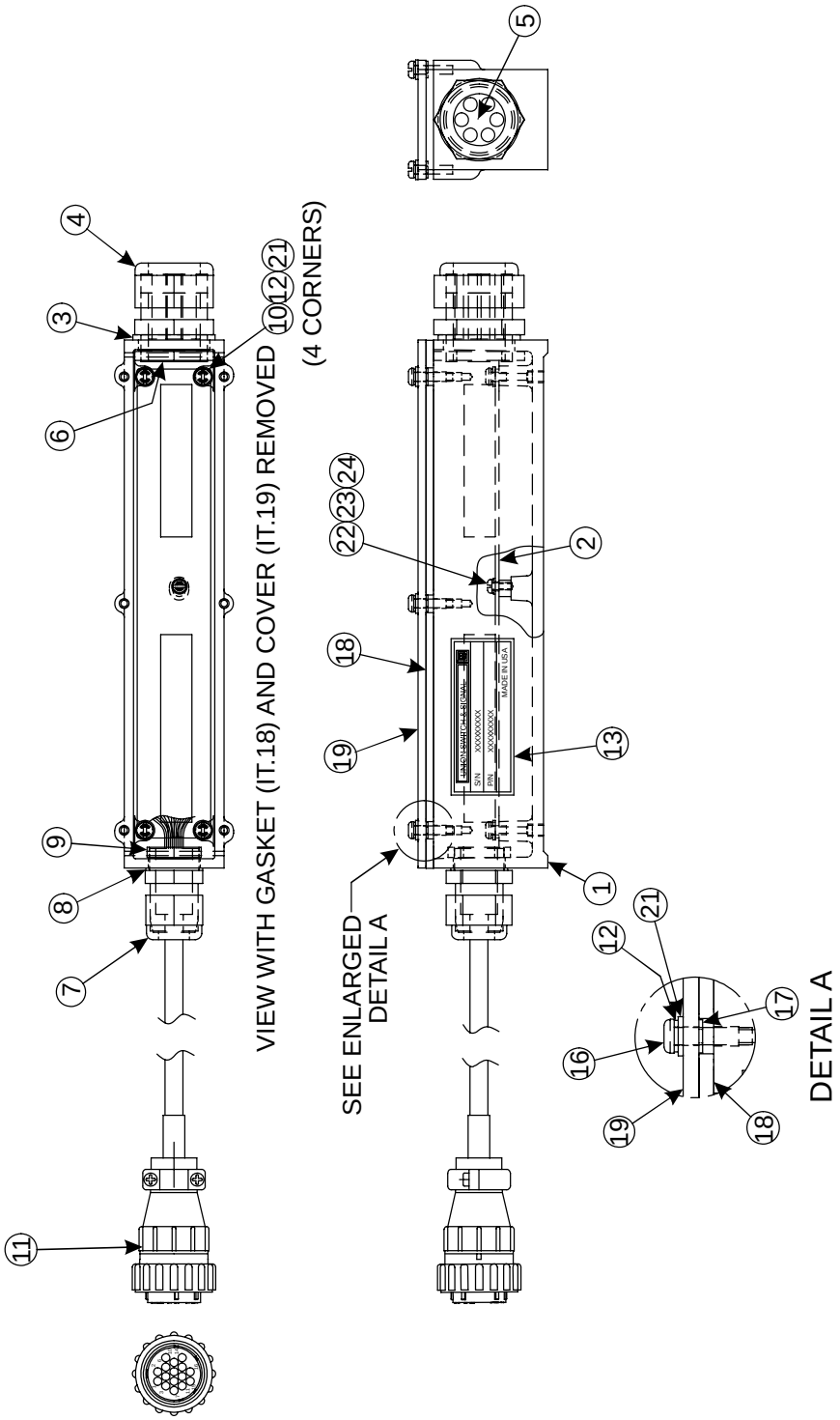


Figure 6-3. Junction Box Assembly

6.4. Point Detector Sensor Assembly Without Auxiliary Sensors (N42252401)

Table 6-6 lists the parts of the point detector assembly without auxiliary sensors and Figure 6-4 shows the parts location.

Table 6-6. Parts List for N42252401

Item No.	Description	ASTS USA Part No.
1	Nut, AAR, Binding14-24, Hex, Brass	J480301
2	Insulator, 5/16” Bolt	M42370801
3	Not Used	
4	Point Sensor PS1	N42307008
5	Lock Washer, M18, Internal Tooth	J4751210138
6	Sensor Holder	M42370202
7	Sensor Bracket Plate	M42370102
8	Terminal Post	M130593
9	Not Used	
10	Point Sensor PS2	N42307009
11	Not Used	

6.5. Point Detector Sensor Assembly With Auxiliary Sensors (N42252402)

Table 6-7 lists the parts of the point detector assembly with auxiliary sensors and Figure 6-4 shows the parts location.

Table 6-7. Parts List for N42252402

Item No.	Description	ASTS USA Part No.
1	Nut, AAR, Binding14-24, Hex, Brass	J480301
2	Insulator, 5/16” Bolt	M42370801
3	Auxiliary Sensor AUX1	N42307007
4	Point Sensor PS1	N42307008
5	Lock Washer, M18, Internal Tooth	J4751210138
6	Sensor Holder	M42370202
7	Sensor Bracket Plate	M42370102
8	Terminal Post	M130593
9	Belleville Washer, Serrated, 5/16”	J4751200169
10	Point Sensor PS2	N42307009
11	Auxiliary Sensor AUX 2	N42307004

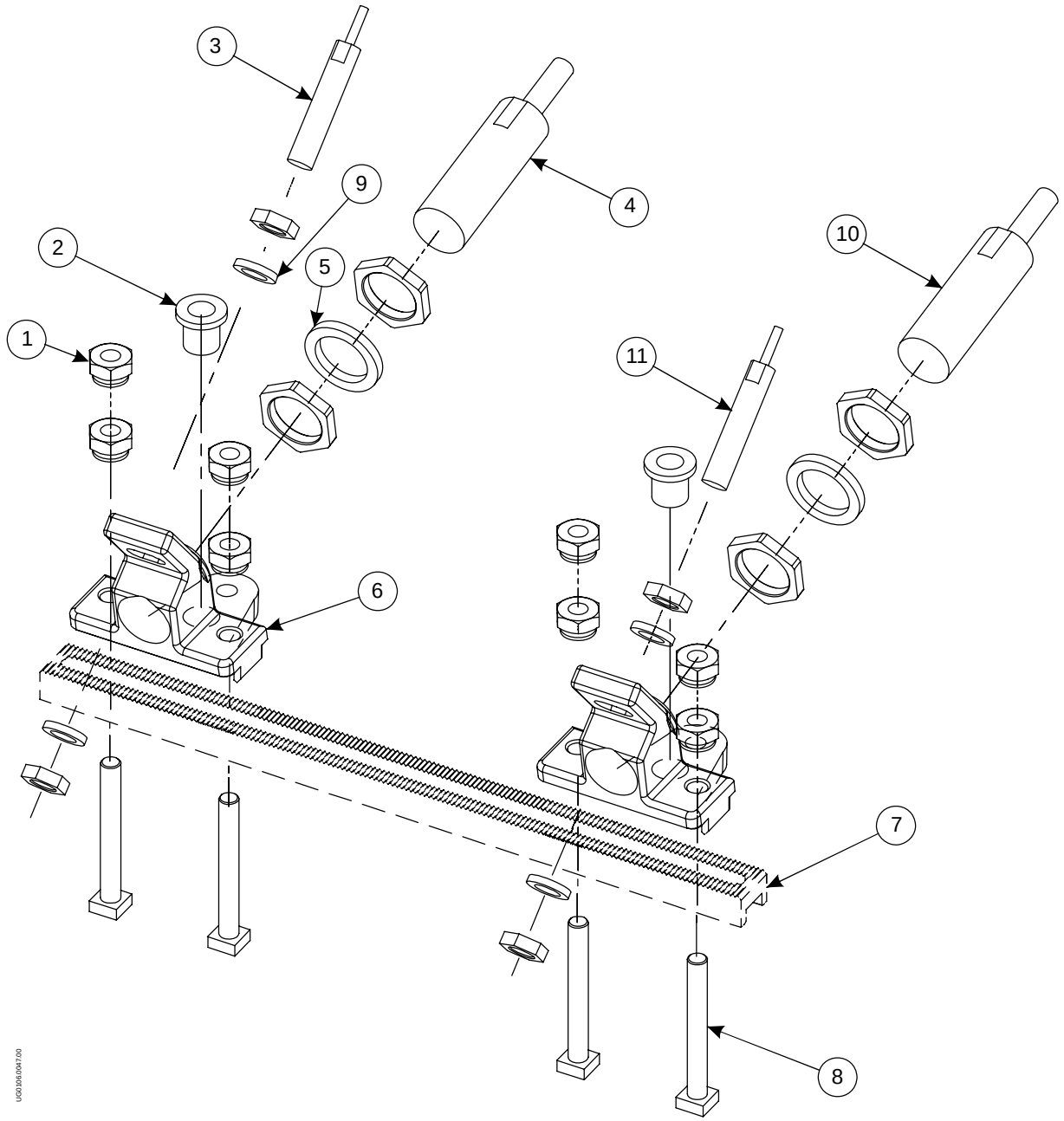


Figure 6-4. Point Detector Sensor Assembly

6.6. Motor Compartment Assembly

Table 6-8 lists the parts of the motor compartment assembly and Figure 6-5 shows the parts location.

Table 6-8. Parts List for the Motor Compartment Assembly

Item No.	Description	ASTS USA Part No.
60	Washer, Lock, 3/8" Steel	J047768
115	Screw, 1/2-13 x 1/2, Hex Hd	J050092
120	Washer, Lock, 1/2 Steel	J047769
140	Screw, 10-32 x 1", Skt Hd Cap	J5001240196
145	Washer, Lock No. 10, SS	J4751210109
165	Washer, No 10, SS	J4751200110
180	Screw, 3/8 x 6 ½" long, Skt Cap	J5001240195
195	Upgraded Motor Controller Unit	N47303901
200	Upgraded Motor Controller Unit	N47303901
205	Gasket, MCU	M42371901
210	Sleeve, AAR Mounting	M42371101
215	Screw, 3/8 x 1 Fl Hd SS	J5001240002
220	Plate, FET Box Insulator	M42371001
225	Side Plate, WAGO	M42371301
230	Washer, 3/8" Lock, Extended Countersink	J4751430002
340	PCB, Surge Suppressor	N49703101
350	Terminal Assembly	N42270301
605	Resistor, 800 ohms, 30 watt	N294241
610	Tag	S000333
615	Clamp, Cable Burndy HP 8N	J700590
620	Screw, 8-32 x 1- 1/4, Rd Hd, Steel	J525111
625	Screw, 8-32 x ½ Fil Hd	J052256
740	Spacer, 3/8" Rd Brass	J725920
745	Cover Plate	M4516112401
2010	Motor Assembly	PN4511611701
3600	Heater Switch	N45116114602
3605	Screw, 8-32 x ½, Pan, SS	J5072950108
3610	Washer, Lock, No. 8, SS	J4751210108

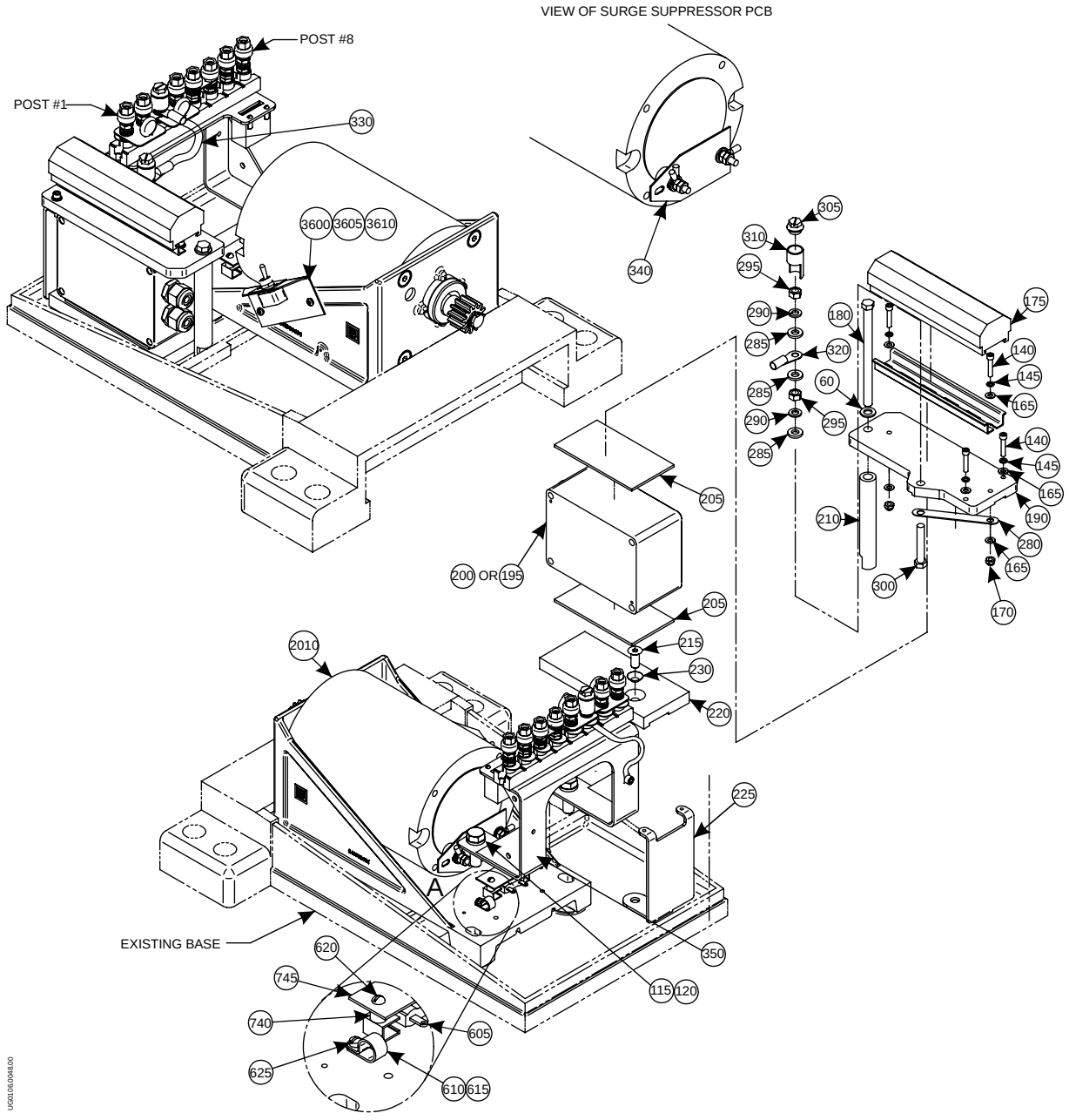


Figure 6-5. Motor Compartment Assembly

6.7. Terminal Assembly (N42270301)

Table 6-9 lists the parts of the terminal assembly and Figure 6-6 shows the parts location.

Table 6-9. Parts List for N42270301

Item No.	Description	ASTS USA Part No.
95	Assembly, 8-Way, AAR Terminal, Permanent Magnet Motor	N42252501
100	Screw, 10-32 X 3/4 Stainless Steel	J5001240014
110	Nut, 1/4-20 Stainless Steel, Elastic Stop Nut	J480260
125	AAR Mounting Bracket Complete	R42252001
130	Screw, 4 X 3/8, Round Head, Type Z	J525054
135	Counter, 6-Digit, 24v, E6B628GM	J6209210051
160	Nut ¼ In. Hex, Steel	J480109
265	Nut, Molded	J048300
310	Insulation, Terminal Sleeve	M281182002
315	Cap, Molded Insulated	J078147
325	Terminal Ring Tongue 324047	J7313990160

6.8. WAGO Assembly (N42270401)

Table 6-10 lists the parts of the WAGO assembly and Figure 6-7 shows the parts location.

Table 6-10. Parts List for N42270401

Item No.	Description	ASTS USA Part No.
140	Screw, 10-32 x 3/4 Stainless Steel	J5001240014
145	Washer, Lock No 10, Stainless Steel	J4751210109
165	Washer, Lock No 12, Stainless Steel	J4751210110
170	Nut,10-32, Hex, Steel Elastic Stop	J048145
175	Terminal Block	N42290102
190	Plate, M-23 ECC WAGO Delrin	M42373001
280	Terminal Strap,M-23 ECC	M42373101
285	Flat Washer, 5/16" Stainless Steel	J4751200149
290	Washer, Lock, 5/16", .322" Inside Diameter	J4751210141
295	Nut, 5/16-18 Hex, Stainless Steel	J4802120104
300	Screw, Hex Head Cap, 5/16-18 x 2"	J5001240194
305	Cap Molded, 5/16-18 T Head	M42316901
310	Insulation, Terminal Sleeve	M281182002
320	Terminal Ring Tongue, 5/16", #6	J7313990174

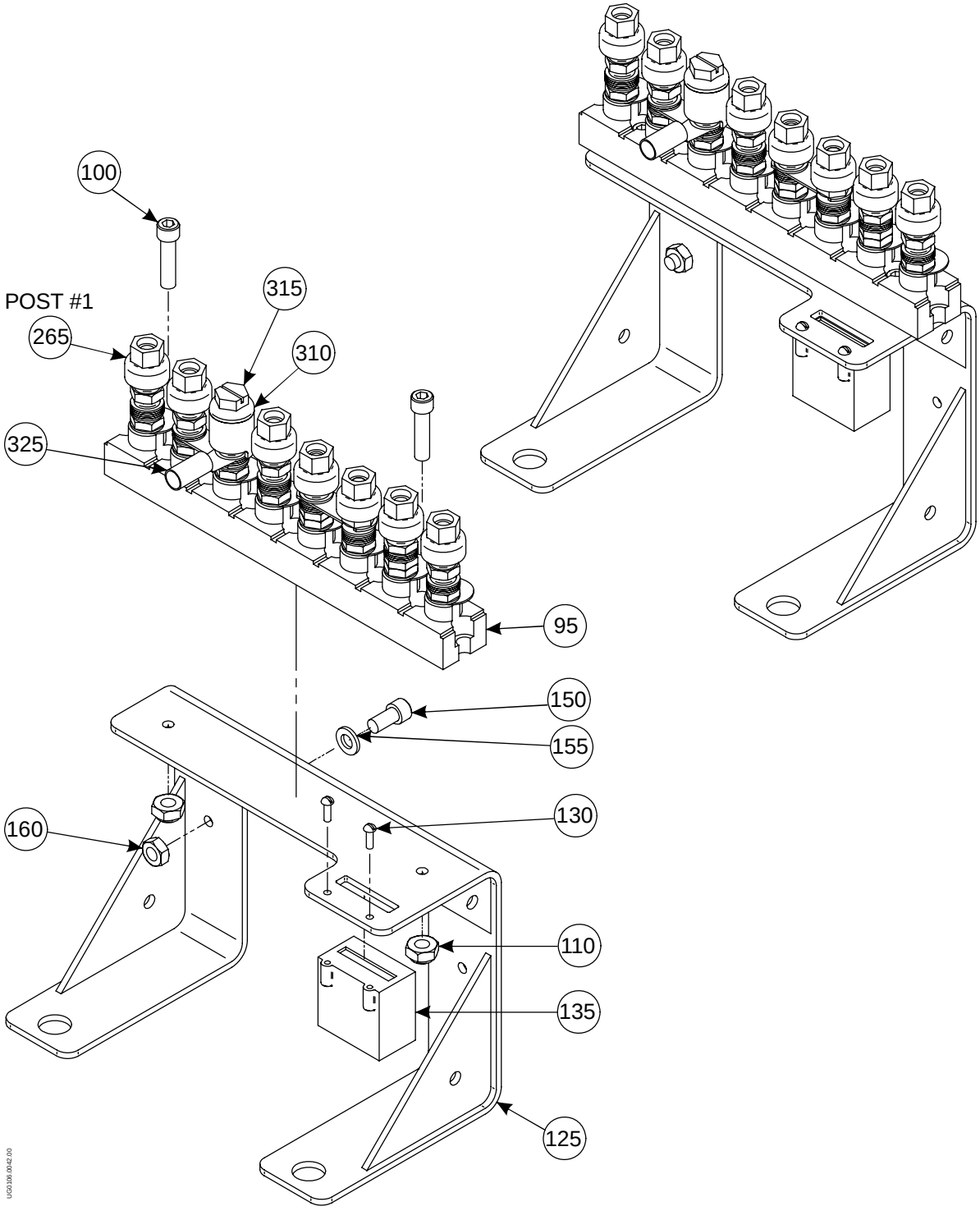


Figure 6-6. Terminal Assembly

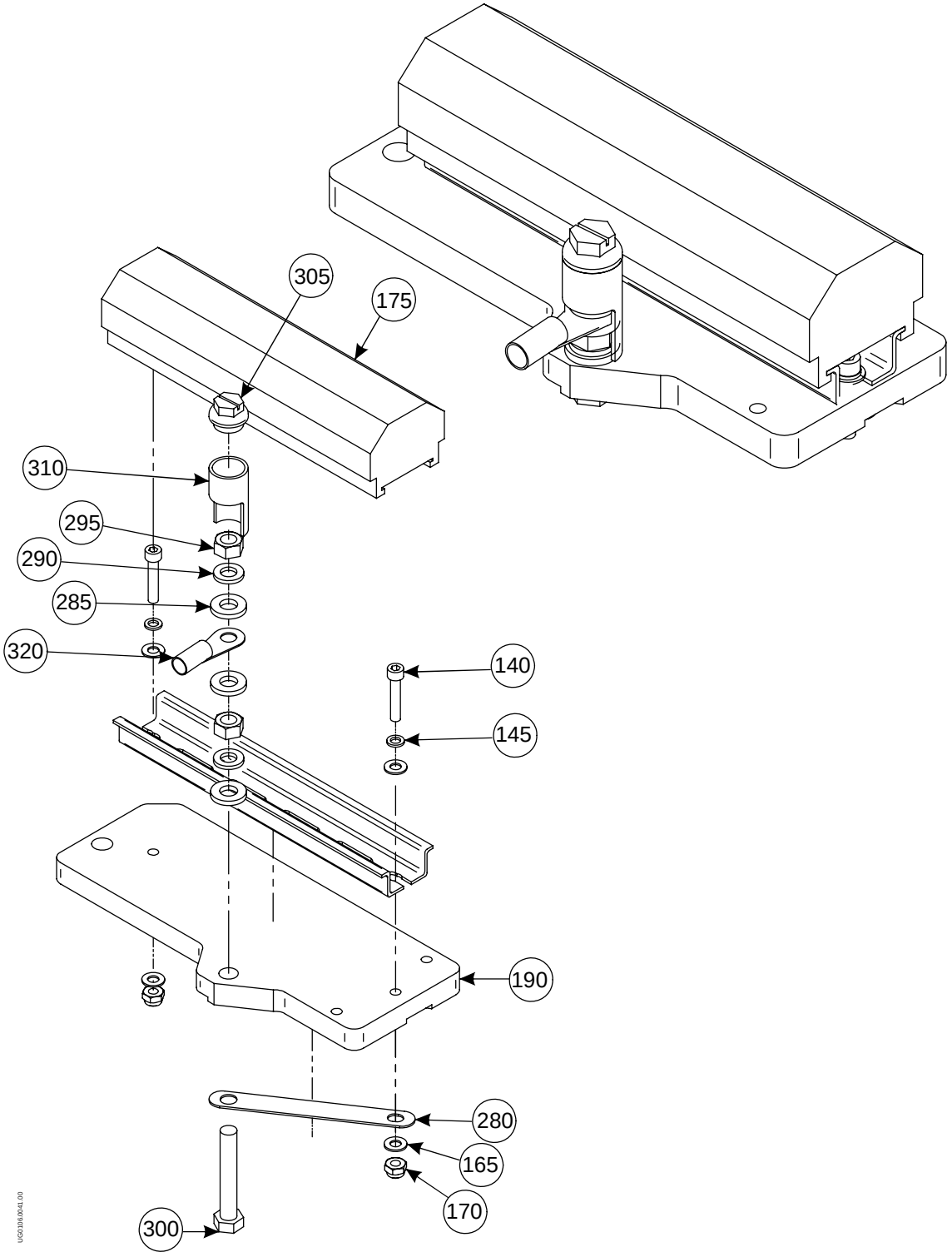


Figure 6-7. WAGO Assembly

6.9. Sensor Use

Table 6-11 lists the sensors that are used with each switch machine. See Figure 3-1 for the sensor locations.

Table 6-11. Sensor and Switch Machine List

MACHINE	TYPE	LOCK 1	LOCK 2	POINT 1	POINT 2	AUX 1	AUX 2
N42250001	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250002	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250003	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250004	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250005	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250006	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250007	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250008	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250009	M-3 ECC	N42307001	N42307002	N42307008	N42307009	x	X
N42250010	M-3 ECC	N42307001	N42307002	N42307008	N42307009	x	X
N42250011	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250012	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250017	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250018	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250019	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250020	M-3 ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250101	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250102	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250103	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250104	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250105	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250106	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250107	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250108	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250109	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250110	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250111	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250112	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250115	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250116	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X

MACHINE	TYPE	LOCK 1	LOCK 2	POINT 1	POINT 2	AUX 1	AUX 2
N42250117	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250118	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250119	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250120	M-23A ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250123	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250124	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250125	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250126	M-23A ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250201	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250202	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250207	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250208	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250209	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250210	M-23B ECC	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
N42250217	M-23B ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250218	M-23B ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250219	M-23B ECC	N42307001	N42307002	N42307008	N42307009	X	X
N42250220	M-23B ECC	N42307001	N42307002	N42307008	N42307009	X	X
X42270001	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270002	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270003	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270004	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270005	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270006	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270007	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270008	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270011	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270012	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270013	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270014	ECC Retro	N42307001	N42307002	N42307008	N42307009	X	X
X42270015	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270016	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270017	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004
X42270018	ECC Retro	N42307001	N42307002	N42307008	N42307009	N42307007	N42307004

7. RAIL TEAM AND TECHNICAL SUPPORT

The Rapid Action Information Link Team (RAIL Team) is a group of experienced product and application engineers ready to assist you to resolve any technical issues concerning this product. Contact the RAIL Team in the United States at 1-800-652-7276 or by e-mail at railteam@ansaldo-sts.us.

End of Manual